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Highlights

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- After joining the WTO, labor markdowns fell more in labor markets exposed to larger input tariff reductions.
- This relative decline in labor markdowns is more pronounced for skill-intensive firms compared with non-skill-intensive firms.
- Firms that have a large skilled labor market share also see their markdowns decrease more in regions with large contemporaneous college expansion reforms.
- Lower labor markdowns due to input trade liberalization offset China's aggregate labor share decline by almost one-half percentage point in the early 2000s.

Trade Liberalization and Labor Monopsony: Evidence from Chinese Firms

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Abstract

We document that larger input tariff reductions were associated with lower labor markdowns in China, especially for skill-intensive firms. Guided by a stylized model of equilibrium labor market power, we leverage differences in the aggregate labor supply dynamics across labor markets—such as regional variations in China’s contemporaneous college expansion reforms—to that show trade-induced labor markdown decreased more in labor markets with more labor supply growth. Our estimates suggest that lower labor markdowns due to input trade liberalization offset China’s aggregate labor share decline by almost one-half percentage point in the early 2000s.

Keywords: input trade liberalization, labor market power, skill intensity, China.

JEL: E2, F1, J2, J3, J42.

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1. Introduction

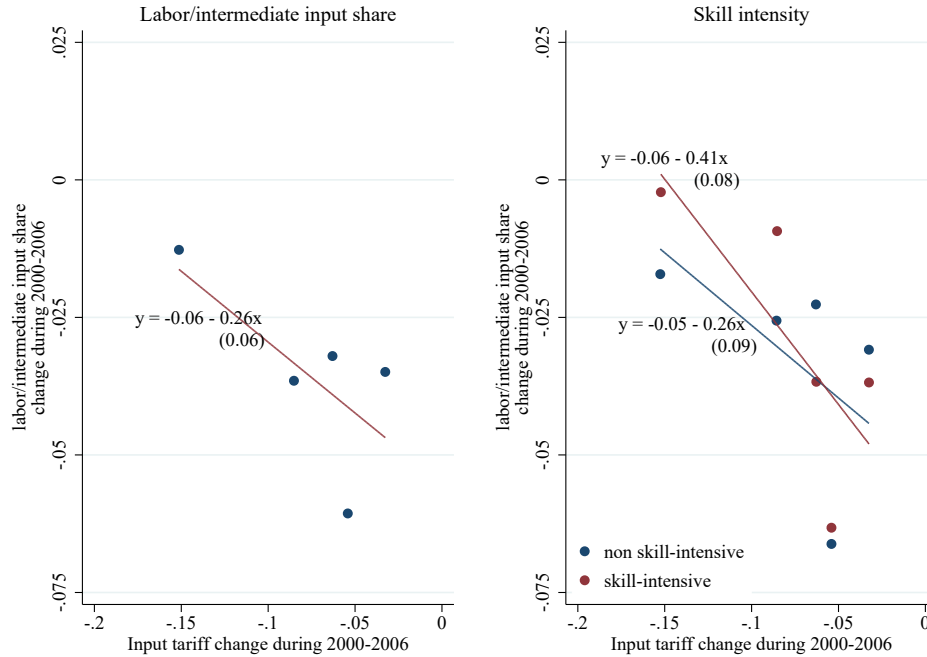
Rising inequality, labor’s declining share of income, and growing protectionism have led to renewed interest in the implications of trade policy for labor markets. While trade reforms can improve consumer welfare, their labor market implications can be uneven, especially when worker reallocation is not frictionless. The literature shows that when trade tariffs fall, industries and locations more exposed to rising import competition can experience lower employment and lower wages relative to less exposed locations (e.g., Davidson and Matusz, 2004; Autor, Dorn and Hanson, 2013; Dix-Carneiro, 2014; Kondo, 2018). Similarly, the labor market effects of trade liberalization have been found to be heterogeneous effects across occupations (e.g., Ebenstein et al., 2014) or by worker skill (e.g., Goldberg and Pavcnik, 2007; Topalova, 2010). Even though labor monopsony power has become a key theme in understanding growing inequality and labor markets (e.g., Rinz, 2018; Hershbein, Macaluso and Yeh, 2022; Berger, Herkenhoff and Mongey, 2022), the literature on international trade and labor markets has typically abstracted from it.¹ In this paper, we study how input trade liberalization affects firms’ market power in labor markets, how firms’ skill intensity shapes this effect, and the role of labor market differences in aggregate labor supply elasticity.

We use China’s unprecedented trade liberalization in the early 2000s to examine the response of firms’ labor monopsony power to trade policies. China is a particularly relevant case for multiple reasons. First, it has the largest labor force in the world, twice as large as the combined labor forces of the U.S. and E.U. It is also the largest economy in the world in PPP (purchasing power parity) terms and one of the world’s largest importers and exporters. Second, labor’s share in China is quite low, standing at approximately 40 percent of value-added in manufacturing in 2001 and has declined since. The nature of China’s

¹The trade literature has traditionally focused more on the monopoly power of firms in their product markets rather than their monopsony power in domestic labor markets. See de Loecker et al. (2016), Fan et al. (2018), and Edmond, Midrigan and Xu (2015), for example, on firm markup strategies in India and China and the competitive effects of trade liberalization.

24 labor market flexibility is disputed, as the well-known Hukou registration system restricts
 25 internal migration across regions. Finally, China’s substantial college expansion reforms
 26 since the late 1990s provide a quasi-natural experiment to test the mechanism at work for
 27 skill heterogeneity in labor market power.

Figure 1: Changes in factor shares and input tariff reductions



Notes: The solid line in the left panel of Figure 1 represents fitted values from regressing changes in the ratio of labor expenditure and intermediate input expenditure on changes in input tariffs using all (non-binned) observations. The regression is shown on the graph, where the value in the bracket is the robust standard error of the coefficient. The dots represent a scatter plot that partitions the data into five quintiles. The right panel of Figure 1 reproduces the same exercise for skill-intensive and non-skill-intensive firms separately. A firm is considered skill-intensive if its fraction of college-educated employees is higher than the average fraction of college-educated employees across all firms in the same 2-digit industry.

28 To motivate our analysis, we regress changes in a proxy for labor market power—the ratio
 29 of labor expenditure and intermediate input expenditure—on changes in input tariffs across
 30 industries. The two panels in Figure 1 show the predicted changes in expenditure shares
 31 against input tariff reductions using a simple linear fit. In the left panel, we note that input
 32 tariff reductions significantly increase the share of expenditures on labor input. The right

33 panel suggests that this increase in labor expenditure shares is larger for skill-intensive firms.

34 Formally, we estimate firms’ monopsony power in labor markets by measuring “labor
35 markdowns,” the wedge between the value of the marginal product of labor and the wage
36 that is above and beyond what is explained by a markup in the output market. We utilize
37 the estimation methods proposed by [Brooks et al. \(2021b\)](#) to distinguish between an output
38 markup and a labor markdown. We use various approaches, such as the methods of [de
39 Loecker and Warzynski \(2012\)](#), to estimate markups.² Using a panel dataset on manufac-
40 turing firms, we estimate that sizeable labor markdowns in Chinese manufacturing.

41 First, we turn to a stylized model of input tariff liberalization and labor monopsony power
42 to analytically characterize how labor markdowns endogenously respond to trade liberaliza-
43 tion and the role of skill intensity. Our model highlights how changes in labor markdowns
44 are an industry equilibrium phenomenon that depends crucially on the aggregate labor sup-
45 ply dynamics: As intermediate input tariffs fall, firms also demand more labor, but this
46 increased labor demand pushes up labor market power if the aggregate labor supply remains
47 unchanged change. Therefore, the model predicts that a key determinant of markdown
48 changes is how aggregate labor supply expands to offset firms’ increased labor demand.

49 Before investigating this aggregate labor supply channel, we exploit variations in the
50 exposure to input tariff reductions across industries in China to document two main empirical
51 findings establishing the impact of the input trade liberalization on firm labor market power
52 in China. First, after joining the WTO, labor markdowns fell more in labor markets exposed
53 to larger input tariff reductions. Second, this relative decline in labor markdowns is more
54 pronounced for skill-intensive firms compared with non-skill-intensive firms. We conduct a
55 number of robustness tests to account for potentially endogenous tariff changes and exporter-
56 specific year-to-year variations. We show that our results are robust to alternative markdown

²Assuming that firms are price-takers in the market for materials, the gap between the value of the marginal product of materials and its price is equal to the output markup. Labor markdowns can then be measured by comparing the ratio of the value of the marginal product of labor to wages with the ratio of the value of the marginal product of materials to its price. See [Appendix B](#) for estimation details.

57 measures and a variety of regression specifications.

58 We then present three pieces of evidence supporting this key insight from our simple
59 theory. First, we confirm that labor markdowns fall more in labor markets in which the
60 aggregate labor expands during trade reform. Second, utilizing college expansion as an
61 exogenous regional shocks to the supply of skilled labor in China, we find that skill-intensive
62 firms in industries that were exposed to larger expansion of skilled labor have a larger decrease
63 in labor markdowns. Finally, firms that have a large skilled labor market share also see their
64 markdowns decrease more in regions with large contemporaneous college expansion reforms.

65 **Related Literature** Our paper broadly relates to three strands of literature: the literature
66 on trade and labor market outcomes, the literature on monopsony power in labor markets,
67 and the literature on trade liberalization and product markups.

68 The trade literature has extensively evaluated the effects of trade liberalization on wages,
69 employment, and inequality (Davidson and Matusz, 2004; Amiti and Davis, 2012; Topalova,
70 2010; Goldberg and Pavcnik, 2007). Recently, the dramatic rise of China’s importance in
71 international trade has motivated a vibrant literature on the labor market effects of trade-
72 induced foreign competition (Autor, Dorn and Hanson, 2013; Pierce and Schott, 2016; Kondo,
73 2018; Caliendo, Dvorkin and Parro, 2019). In contrast to the literature, we allow for labor
74 market power. This departure allows us to isolate one potentially important determinant
75 of both measured wages and employment: the effects of trade on labor markdowns. Our
76 findings suggest that labor monopsony power can influence the skill premium, as trade-
77 induced markdowns vary with skill intensity. Our work also emphasizes to role of labor
78 market heterogeneity in labor supply elasticity.

79 A growing number of papers investigate labor monopsony, mainly in developed countries
80 such as the United States (Card et al., 2018; Gouin-Bonenfant, 2022; Lamadon, Mogstad and
81 Setzler, 2022; Berger, Herkenhoff and Mongey, 2022; Hershbein, Macaluso and Yeh, 2022;
82 Macedoni, 2022; Pham, 2023). We borrow our labor markdown estimation from Brooks

83 [et al. \(2021a\)](#) and [Brooks et al. \(2021b\)](#), who also study on labor markdowns in India
84 and China. This paper contributes to this literature by looking at the impact of trade
85 liberalization on firms' labor monopsony power. In this regard, our paper complements
86 existing findings in [Pham \(2023\)](#) and [Dobbelaere and Wiersma \(2020\)](#), who also document
87 lower labor markdowns following trade liberalization in China. Our contributions consist of
88 new findings on the role of firm skill intensity, new evidence on the labor supply elasticity
89 channel, and macroeconomic implications for the labor share and the skill premium. In
90 contrast to the findings in China, [Felix \(2022\)](#) finds that output trade liberalization in
91 Brazil *increased* labor markdowns, using a structural approach and trade-induced changes
92 in concentration to estimate economy-wide labor supply elasticity parameters.

93 Our paper also relates to the literature on the competitive effects of trade liberalization.
94 [Edmond, Midrigan and Xu \(2015\)](#) and [Arkolakis et al. \(2019\)](#) provide theoretical and quan-
95 titative insights into the effects of trade in the presence of variable markups. More recent
96 studies estimate the impact of trade liberalization on firm markup (e.g., [de Loecker et al.](#)
97 [\(2016\)](#) for India, and [Fan et al. \(2018\)](#) for China). We estimate labor markdowns as the ratio
98 of the labor-based markup and materials-based markup. We show that the trade-induced fall
99 in labor markdowns that we document are not systematically due to higher product markups.
100 Specifically, we find that trade-induced labor markdowns fall more for skill-intensive firms,
101 but their product markups do not change more.

102 The remainder of this paper is organized as follows. In Section 2, we introduce a sim-
103 ple model of equilibrium labor markdowns following input tariff liberalization. Section 3
104 describes the firm-level data, our markup estimation methods, and our findings on the im-
105 pact of tariff reductions on labor markdowns as well as the role of skill intensity and spatial
106 variations in labor supply adjustments. In Section 4, we investigate the implications of our
107 findings for the aggregate labor share and for the wage premium at skill-intensive firms.
108 Section 5 concludes.

2. A Simple Model of Markdowns and Input Tariffs

We now provide a simple model of endogenous markdowns following input tariff liberalization. We aim to derive analytically, in a minimal model, the effects of input tariff liberalization on labor markdowns. The model is therefore deliberately stylized and focused on deriving potential mechanisms behind the motivating facts above. The model is also consistent with the more general accounting framework used to estimate markups and labor markdowns in the data. Detailed model derivations are in [Appendix C](#).

Environment

We consider an economy in which firms are price-takers in the market for intermediate inputs but can exercise labor market power in their local labor market, indexed by $k \in \mathcal{K}$. A labor market k is populated by a mass L_k of workers who elastically supply labor to the discrete set $\mathcal{I}_k = \{1, \dots, N_k\}$ of firms operating locally.

First, we present the key assumptions we make to solve each firm's input choice problem. We then focus, for tractability, on a symmetric equilibrium concept to derive closed-form solutions for the impact of trade liberalization on labor markdowns and highlight the role of skill-intensity and the degree of local labor supply adjustments.

Assumption 1 (Cobb-Douglas production function). *The production function satisfies $y_i = z_i F(\ell, m) = z_i \ell^\lambda m^\mu$ with $\lambda > 0$, $\mu > 0$. The implied output elasticities with respect to labor and materials satisfy $\theta_\ell(\ell, m) = \lambda$ and $\theta_m(\ell, m) = \mu$.*

Assumption 2 (Constant inverse demand elasticity). *The inverse demand function satisfies $p(y_i) = Ay_i^{-\sigma-1}$ with $\sigma > 1$ and $A > 0$. The inverse product demand elasticity faced by the firm is therefore given by $-\sigma_i^{-1}(y_i) = -\sigma^{-1}$.*

Assumption 3 (Wage function). *Given other firms' labor demands $\{\ell_j : j \neq i\}$, the wage function for a given firm i demanding ℓ_i units of labor in labor market k satisfies*

$$w_{i,k}(\ell_i, \cdot) = \left[\frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi} \right]^{\frac{\eta}{\varphi}} (\mathcal{L}_{-i}^\varphi + \ell_i^\varphi)^{\frac{\nu}{\varphi}},$$

131 where $\mathcal{L}_{-i}^\varphi \triangleq \sum_{j \neq i, j \in \mathcal{I}_k} \ell_j^\varphi$.

132 The inverse labor supply elasticity faced by firm i is

$$\varepsilon_{i,k}^{-1}(\ell_i) \equiv \frac{\partial \log w_{i,k}(\ell_i)}{\partial \log \ell_i} = \eta + (\nu - \eta) \frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi}. \quad (1)$$

133 For instance, in the common iso-elastic case; that is, $(\nu - \eta = 0)$, the firm-level inverse
 134 labor supply elasticity $\varepsilon_{i,k}^{-1}(\ell_i)$ is constant, and the labor markdown $(1 + \varepsilon_{i,k}^{-1}(\ell_i))$ does not
 135 vary with tariffs. Also, the cross-firm labor supply elasticity φ may be location-specific. In
 136 fact, we derive such labor supply function in an environment with labor supply choice across
 137 a continuum of locations in [Appendix D](#).³

138 Firm Problem

139 The problem of a firm i located in location k , given the inverse demand function $p(y_i; \cdot)$, the
 140 choices of other firms $\{\ell_j\}_{j \neq i}$, and intermediate input prices $r_k \equiv (1 + \tau_k)\tilde{r}$ is

$$\begin{aligned} \max_{\ell_i, m_i} \quad & p(y_i; \cdot)y_i - w_{i,k}(\ell_i; \cdot)\ell_i - r_k m_i \\ \text{s.t.} \quad & y_i = z_i F(\ell_i, m_i) \end{aligned} \quad (2)$$

³A standard result in the literature is that that the firm's inverse labor supply elasticity is correlated with its labor market share. This formulation implies the same correlation: here $\varepsilon_{i,k}^{-1}(\ell_i) = \eta + (\nu - \eta)\tilde{s}_{i,k}^{-1}$, where $\tilde{s}_{i,k}^{\frac{\varphi}{1+\eta}} = (w_{i,k}\ell_{i,k})^{\frac{\varphi}{1+\eta}} / \sum_{j \in \mathcal{I}_k} (w_{j,k}\ell_{j,k})^{\frac{\varphi}{1+\eta}}$ is correlated with firm i 's labor market share.

141 where τ_k denotes tariffs and \tilde{r} is the world price for intermediate input materials.⁴

142 While the firm is price-taking in the market for intermediate inputs m , it can exercise
 143 labor market power when hiring labor ℓ in its labor market k ; that is, $\frac{\partial w_{i,k}}{\partial \ell_i} \neq 0$, where $w_{i,k}$
 144 denotes the wage in i 's labor market k .⁵

145 **Lemma 1** (Labor market power as labor wedge). *The firm optimality conditions imply the*
 146 *standard formulation that labor market power, in the sense of positive firm-level inverse labor*
 147 *supply elasticities ($\varepsilon_{i,k}^{-1}(\ell_i) > 0$), acts as a wedge distorting the allocation of labor relative to*
 148 *the competitive market allocation:*

$$\frac{F_{\ell_i}(\cdot)}{F_{m_i}(\cdot)} = \frac{\lambda}{\mu} = \frac{w_{i,k}(\ell_i)}{r_k} [1 + \varepsilon_{i,k}^{-1}(\ell_i)]. \quad (3)$$

149 Following the literature, we define labor markdowns as the labor-based markup divided
 150 by the materials-based markup, an input for which we assume the firm is a price-taker.

151 **Lemma 2** (Labor markdowns). *The labor markdown—the ratio of the labor-based markup*
 152 *and the materials-based markup— for firm i equals*

$$[1 + \varepsilon_{i,k}^{-1}(\ell_i)]. \quad (4)$$

153 This lemma naturally follows from the fact that the labor-based markup satisfies

$$\frac{z_i F_{\ell_i}(\cdot)}{w_{i,k}(\ell_i)} p(y_i) = [1 + \varepsilon_{i,k}^{-1}(\ell_i)] [1 - \sigma_i^{-1}(y_i)]^{-1} = [1 + \varepsilon_{i,k}^{-1}(\ell_i)] (1 - \sigma^{-1})^{-1} \quad (5)$$

⁴In the model, a firm's location refers to the labor market in which it competes for workers, which can be industry- and location- specific. We therefore allow tariffs τ_k to vary by location. More generally, domestic trade frictions may further affect the input tariffs faced by the firms in a given labor market.

⁵We build a model to explain specifically the relationship between input tariff liberalization and labor markdowns. We can easily extend the model to include output tariffs. We focus on input tariff liberalization because we view it as a shock to relative input prices as opposed to a final demand shock. While both shocks change the relative demand for both inputs, we think the shock to local relative input prices is better suited for isolating changes in local labor market power.

154 and the materials-based markup satisfies

$$\frac{z_i F_{m_i}(\cdot)}{r_k} p(y_i) = [1 - \sigma_i^{-1}(y_i)]^{-1} = (1 - \sigma^{-1})^{-1}. \quad (6)$$

155 Optimal Labor Demand

156 Substituting for the optimal materials choice, the firm's problem can be re-written as the
157 labor choice problem below

$$\max_{\ell_i} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} - w_{i,k}(\ell_i; \cdot) \ell_i \quad (7)$$

158 where $B(r_k) \triangleq (1 - \tilde{\mu}) [\tilde{\mu}/r_k]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} [A]^{\frac{1}{1-\tilde{\mu}}}$, $\tilde{z}_i \triangleq z_i^{1-\sigma^{-1}}$, $\tilde{\mu} \triangleq [1 - \sigma^{-1}] \mu$, and $\tilde{\lambda} \triangleq [1 - \sigma^{-1}] \lambda$.

159 The first-order conditions with respect to ℓ_i imply that the equilibrium labor allocations
160 $\{\ell_i\}_i$ across firms jointly satisfy a system of equations such that

$$\frac{\tilde{\lambda}}{1 - \tilde{\mu}} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} \times \frac{1}{w_{i,k}(\ell_i; \cdot) \ell_i} = 1 + \varepsilon_{i,k}^{-1}(\ell_i) \quad \forall i. \quad (8)$$

161 **Theorem 3** (Optimal labor demand). *The optimal labor demanded by firm i , given other
162 firms' strategies \mathcal{L}_{-i} and given intermediate input prices $r_k \equiv (1 + \tau_k) \tilde{r}$, solves*

$$\left(1 + \eta + (\nu - \eta) \frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi} \right) \left(\frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi} \right)^{\frac{-(\nu-\eta)}{\varphi}} \ell_i^{(1+\nu) - \frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1 - \tilde{\mu}} B(r_k) [\tilde{z}_i]^{\frac{1}{1-\tilde{\mu}}}. \quad (9)$$

163 The optimal labor demand equation implicitly defines the firm's labor demand as a
164 function of the other firms' strategies \mathcal{L}_{-i} and the material price $r_k \equiv (1 + \tau_k) \tilde{r}$. The
165 dependence on other firms' decisions highlights that markdowns are jointly determined as a
166 labor market equilibrium outcome.

167 For the remainder of the paper, we focus on symmetric equilibria where all local firms are
168 homogeneous and choose the same allocations. Though stylized, the symmetry restriction

169 allows us to derive intuitive closed-form results.⁶

170 **Corollary 4** (Symmetric Local Equilibrium and Entry). *In a symmetric equilibrium (that*
 171 *is, $z_i = z_k$ and $\ell_i = \ell_k \forall i \in N_k$), given materials prices r_k and aggregate labor L_k , the*
 172 *number of firms N_k satisfies*

$$\left(N_k\right)^{\frac{(\nu-\eta)}{\varphi}} \left(1 + \eta + (\nu - \eta) \frac{1}{N_k}\right) \left(\frac{L_k}{N_k}\right)^{(1+\nu) - \frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1 - \tilde{\mu}} [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k)$$

173 with $\ell_k = \frac{L_k}{N_k}$. Furthermore, the labor markdown is $[1 + \varepsilon_k^{-1}(\ell_k)] = 1 + \eta + \frac{(\nu-\eta)}{N_k}$.

174 With symmetric firms, if the labor supply does not expand, fewer firms would operate
 175 in response to increased labor demand arising from lower input prices r_k and labor market
 176 power will rise.

177 Having taken the local labor supply of workers L_k as given in order to characterize the
 178 firm solution and local equilibrium, the next assumption governs how tariff-induced wage
 179 changes affect the local labor supply.

180 **Assumption 4** (Aggregate labor supply elasticity). *Input tariff changes affect equilibrium*
 181 *labor supply through wages such that*

$$\frac{\partial \log L_k}{\partial \log((1 + \tau_k)\tilde{r})} = \frac{\partial \log L_k}{\partial \log w_k} \times \frac{\partial \log w_k}{\partial \log((1 + \tau_k)\tilde{r})} \triangleq -\kappa \leq 0.$$

182 **Discussion of Assumption 4:** This assumption is a reduced-form way of capturing the
 183 elasticity of labor supply across labor markets when intermediate input tariffs change. In
 184 a full model with labor market choice across locations, this elasticity would be endogenous
 185 to optimal labor allocations through labor markets clearing within and across locations. In
 186 the case of a continuum of locations shown in [Appendix D](#), the elasticity of local labor
 187 to the local wage index is a constant, but the transmission of tariff reductions into local

⁶More generally, in the heterogeneous-firms case, the change in the aggregate labor demand will feature both the extensive and the intensive margins of the firms that operate in equilibrium and their size.

188 wages is endogenous. Note also, that in [Appendix D](#), the households' labor supply elasticity
189 parameter may vary across labor markets.⁷ As a result, the implied values for the aggregate
190 labor supply elasticity κ may vary across local labor markets. This is an important source
191 of heterogeneity for our empirical strategy.

192 This assumption therefore captures how local labor force dynamics can offset standard
193 selection and entry mechanisms that typically lead to higher labor market power when the
194 mass of workers does not change. We formalize this finding in the theorem below.

195 First, we note that taking derivatives $\frac{\partial}{\partial \log r_k}$ on the equilibrium conditions, we get

$$\frac{\partial \log N_k}{\partial \log r_k} = \frac{\left(\frac{\tilde{\mu}}{1-\tilde{\mu}}\right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu\right) \kappa}{\left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi}\nu + \frac{\eta}{\varphi}\right) + \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-1}}$$

196 by applying the chain rule and substituting for the aggregate labor supply elasticity term.⁸

197 The labor supply elasticity under symmetry implies $\log N_k = -\log(\varepsilon_k^{-1} - \eta) + \log(\nu - \eta)$.

198 Therefore,

$$\frac{\partial \log(\varepsilon_k^{-1} - \eta)}{\partial \log r_k} = -\frac{\left(\frac{\tilde{\mu}}{1-\tilde{\mu}}\right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu\right) \kappa}{\left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi}\nu + \frac{\eta}{\varphi}\right) + \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-1}}. \quad (10)$$

⁷In the random utility framework, workers draw idiosyncratic preference shocks across labor markets that may differ in switching costs, local amenities, or local wages. [Artuç, Chaudhuri and McLaren \(2010\)](#), [Dix-Carneiro \(2014\)](#), [Redding \(2016\)](#), and [Caliendo, Dvorkin and Parro \(2019\)](#) use random utility discrete choice models to investigate the labor market effects of trade reforms. With more discrete options, such quantitative models also have more degrees of freedom to fit observed choice probabilities across options. [Berger, Herkenhoff and Mongey \(2022\)](#) allow for strategic firm behavior within and across discrete locations, in the oligopolistic approach of [Atkeson and Burstein \(2008\)](#), to study firm labor monopsony power. The assumption of a continuum of locations in our extension (see [Appendix D](#)) allows us analytically to maintain oligopsonistic firm behavior locally, *within* but not *across* labor markets—thanks to insights from [Malmberg \(2013\)](#) and [Malmberg and Hössjer \(2018\)](#) who characterize the infinite limit case of random discrete choice problems. Specifically, [Berger, Herkenhoff and Mongey \(2022\)](#) (see Appendix B in their paper) build on these findings to motivate a more convenient constant-elasticity-of-substitution (CES) formulation of the labor supply choice *across* labor markets.

⁸Technically, the equilibrium number of firms N_k needs to be an integer. We consider the equilibrium condition on the real line for the purpose of our variational analysis.

199 **Theorem 5** (Intermediate input prices and labor market power). *Labor markdowns* $(1 + \varepsilon_k^{-1})$
 200 *decline (and the equilibrium number N_k of firms increases) with lower intermediate input*
 201 *prices iff*

$$\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right) - \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu \right) \kappa < 0 \iff \kappa > \frac{\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right)}{\left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu \right)}. \quad (11)$$

202 This theorem summarizes a key insight from our simple model: While the firm-level
 203 labor supply elasticity shapes the firm's labor market power, its equilibrium labor markdown
 204 response to a change in input tariffs critically depends on the aggregate labor supply elasticity
 205 also. We test this insight empirically using spatial variation in local labor supply dynamics.

206 Before turning to the evidence supporting this mechanism, we also characterize the role
 207 of skill intensity in the effect of input trade liberalization on markdowns. We explore the
 208 role of skill intensity in the context of our model by applying $\frac{\partial}{\partial \tilde{\lambda}}$ to $\frac{\partial \log N_k}{\partial \log r_k}$.

209 We then obtain, after some transformations,⁹

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{\left(\frac{1}{1 - \tilde{\mu}} \right) \left\{ \left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right) - \kappa \left(\frac{\nu - \eta}{\varphi} \right) + \kappa \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1} \right\}}{\left\{ \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \frac{\varphi - 1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &+ \frac{\left(\frac{1 + \eta}{\nu - \eta} \right) \left[\left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu \right) \kappa - \left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right) \right] \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-2}}{\left\{ \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \frac{\varphi - 1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\times \frac{\left(\frac{1}{1 - \tilde{\mu}} \right) N_k \left(\log \frac{L_k}{N_k} + \frac{1 - \tilde{\mu}}{\tilde{\lambda}} \right)}{\left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \frac{\varphi - 1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1}}. \end{aligned}$$

⁹Since $N_k \geq 1$ and $\nu > \eta > 0$, $\kappa \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1} \in \left(0, \kappa \frac{\nu - \eta}{1 + \nu} \right]$, which implies

$$\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right) - \kappa \left(\frac{\nu - \eta}{\varphi} \right) + \kappa \left[\left(\frac{1 + \eta}{\nu - \eta} \right) N_k + 1 \right]^{-1} > \left(\frac{\tilde{\mu}}{1 - \tilde{\mu}} \right) - \kappa \left(\frac{\nu - \eta}{\varphi} \right).$$

210 The equation above allows us to characterize whether the cross-derivative is positive:
 211 that is, whether, an input tariff reduction leads to a larger labor markdown reduction when
 212 the skill intensity is higher.

213 **Theorem 6** (Labor intensity, input tariffs, and equilibrium number of firms). *Skill intensity*
 214 *amplifies the increase in the number of firms and, equivalently, the associated reduction in*
 215 *markdowns arising from a decline in input prices; that is,*

$$\frac{\partial \log N_k}{\partial \log r_k} < 0 \quad \text{and} \quad \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} > 0,$$

216 *when*

$$\kappa \in \left(\frac{\frac{\tilde{\mu}}{1-\tilde{\mu}}}{\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu}, \frac{\frac{\tilde{\mu}}{1-\tilde{\mu}}}{\frac{\nu-\eta}{\varphi}} \right). \quad (12)$$

217 Note that Theorem 6 imposes restrictions on the labor supply elasticity for this amplifi-
 218 cation result to be true.¹⁰ Overall, our theorems show how endogenous markdowns respond
 219 to tariff reductions, albeit in a stylized environment. Our results emphasize the key role
 220 played by the local aggregate labor supply elasticity: changes in labor demand combined
 221 with reallocation in labor supply across labor markets both matter. The mechanics are sim-
 222 ple enough that we think a version of our “possibility” of pro-competitive result may hold in
 223 a more general setup. These results motivate us to consider heterogeneous local labor supply
 224 elasticities when investigating equilibrium labor markdown dynamics after tariff reductions.

225 In the next section, we document the effects of input tariffs reductions on labor mark-
 226 downs along with the role of skill intensity before exploring suggestive evidence on the labor
 227 supply mechanisms highlighted in Theorems 5 and 6. Specifically, we estimate firm-level
 228 markdowns and leverage both exogenous variations in input tariff changes and the contem-
 229 poraneous reforms which drastically increase college admissions in China.

¹⁰The condition in Theorem 6 requires $1 + \left(1 - \frac{1}{\varphi}\right)\nu + \frac{\eta}{\varphi} > \frac{\tilde{\lambda}}{1-\tilde{\mu}}$. This necessary condition guarantees the existence of κ and is always true, since $1 + \left(1 - \frac{1}{\varphi}\right)\nu + \frac{\eta}{\varphi} > 1 > \frac{\tilde{\lambda}}{1-\tilde{\mu}}$.

230 **3. Empirical Strategy and Findings**

231 **3.1. Data and Measurements**

232 The main dataset used in the analysis is the firm-level production data from the Annual
233 Survey of Chinese Industrial Enterprises (CIE). The CIE data are collected by the National
234 Bureau of Statistics of China, and they cover all state-owned enterprises (SOEs), and non-
235 state-owned enterprises with annual sales of at least 5 million RMB (approximately \$760,000
236 in 2020). Between 2000 and 2006, the number of firms in the CIE data grew from approx-
237 imately 162,000 to 300,000, making our sample unbalanced panel. We focus only on the
238 manufacturing sector and 4-digit manufacturing industries.

239 The tariff data come from the World Trade Organization (WTO) website. The liberal-
240 ization episode involves both time and industry variations. The liberalization was sudden,
241 involving a sharp and sudden cut in tariff rates in 2001. Tariffs went from being high and
242 variable across industries to being low and less variable. Moreover, preexisting regional dif-
243 ferences in industrial composition led to regional variation in the impact on labor markets.¹¹
244 We map the tariff data at the 8-digit harmonized system (HS) product level into a 3-digit
245 input/output (IO) industry classification based on the HS codes and the China’s 2002 IO
246 table. Our 3-digit output tariffs are just the simple average of all tariffs for products whose
247 8-digit HS map into a given 3-digit IO industry code. Following [Amiti and Konings \(2007\)](#),
248 we compute 3-digit input tariffs as an input-cost weighted average of output tariffs:

$$\tau_{it}^{\text{input}} = \sum_k \alpha_{ki} \tau_{kt}^{\text{output}},$$

249 where $\tau_{kt}^{\text{output}}$ is the 3-digit output tariffs imposed on industry k at time t , and α_{ki} is the
250 percentage of industry i ’s total costs that were expended on products supplied by industry

¹¹The liberalization also disproportionately impacted industries that initially had high tariffs. Specifically, industries with initially high tariffs experienced greater tariff reductions when China joined the WTO.

251 k as intermediate inputs for industry i . Finally, we map IO 3-digit tariffs into the 4-digit
252 Chinese Industrial Classification (CIC) code system so that we can merge it with our firm-
253 level production data.

254 Recall that labor markdown can be written as the ratio of the labor-based markup and
255 the materials-based markup. Moreover, we can derive markups from factor payment shares
256 and output elasticities. Combining these two results, we estimate labor markdowns using
257 the following equation:

$$\text{Labor markdown} = \frac{\theta_{l_i}}{\alpha_{l_i}} \cdot \frac{\alpha_{m_i}}{\theta_{m_i}}$$

258 where α_{l_i} and α_{m_i} represent labor and materials payment shares for firm i . θ_{l_i} and θ_{m_i}
259 represent output elasticities from firm i 's production function with respect to materials and
260 labor. We compute values of labor and materials payment shares directly from the data. To
261 estimate output elasticity with respect to materials, we apply the methods of [de Loecker and](#)
262 [Warzynski \(2012\)](#) and estimate firms' production functions. Following [Brooks et al. \(2021b\)](#),
263 we set the output elasticity with respect to labor to be a constant and estimate the value of
264 the constant using an auxiliary regression between labor markdowns and firms' labor market
265 shares. Details on our labor markdown estimation steps are in [Appendix B](#).¹²

¹²The benefit of using the auxiliary regression between firms' labor markdowns and their labor market shares is that we will only attribute the part of firms' labor markdowns that comove with their labor market shares to monopsony power. This is consistent with our theory and the rest of the literature: a firm's labor market power is correlated with their labor market share (see the discussion of Equation 1 on the firm's residual labor supply elasticity).

Table 1: Summary statistics

	Mean	Median	SD
Markup (baseline)	1.27	1.24	0.19
Markup (alter-CD)	1.12	1.10	0.16
Markup (alter-CRS)	1.13	1.12	0.16
Markdown (baseline)	1.03	0.61	1.22
Markdown (alter-CD)	1.03	0.61	1.21
Markdown (alter-CRS)	1.02	0.64	1.12
Capital per firm (real value, 000s RMB)	305	46	3193
Materials per firm (real value, 000s RMB)	634	154	4888
Output per firm (real value, 000s RMB)	861	217	6454
Workers per firm	299	125	1026
No. of firm-year Obs	868342		

Notes: Market shares are computed using 4-digit industries. Capital, materials, and output are in thousands of RMB (in real value). The table winsorizes the 3 percent in both sides of the markup/markdown estimates of each 2-digit industry in each year. Markup (baseline) is estimated following the methods of de Loecker and Warzynski (2012). Markup (alter-CD) is estimated assuming a Cobb-Douglas production technology. Markup (alter-CRS) is estimating assuming that the production function is constant returns to scale. Markdown (alter-CD) is computed using markup (alter-CD), and markdown (alter-CRS) is computed using markup (alter-CRS).

266 Table 1 gives the summary statistics for the important measures in our data. The average
267 values for markups range from 1.12 to 1.27, and the markdowns averaged approximately
268 3 percent across different measures. Notice that there is substantial variation in the measures
269 of markdowns, and the markdown distributions are strongly skewed to the left. Since many
270 of the results are robust to different measures of markups and markdowns, in text, we present
271 only the results using the baseline measure and we leave those using the alternative measures
272 to the appendix.

273 3.2. Results

274 In this section, we report our empirical findings on the impact of input trade liberalization
275 on labor markdowns. We find that input tariff reductions are associated with lower labor
276 markdowns across Chinese manufacturing firms. Moreover, firms that are more skill-intensive
277 also reduce labor markdowns more following input tariff reductions. Our main findings are
278 robust to alternative markdown measurements and a variety of alternative specifications,
279 including long difference estimations and difference-in-difference estimations.

280 3.2.1. Trade Liberalization and Labor Markdowns

281 To document the effect of trade liberalization on labor markdowns, we adopt the following
282 regression specification:

$$\log(\mu_{ist}) = \alpha_1 \text{tariff}_{st} + \mathbf{X}_{ist}\beta + \delta_t + \delta_s + \delta_i + \epsilon_{ist}, \quad (13)$$

283 where $\log(\mu_{ist})$ denotes the logarithm of firm-level markdowns by firm i in year t , and tariff_{st}
284 denotes the input or output tariff at time t in a 4-digit CIC industry s . The vector of con-
285 trols, \mathbf{X}_{ist} , contains firm-level characteristics that could potentially influence the dynamics
286 of markups and markdowns. These controls include the logarithm of total output, the size of
287 employment, the capital-labor ratio, and total labor payments. We also control for the time
288 fixed effect (δ_t), the 2-digit CIC sector/industry fixed effect (δ_s), and the firm fixed effect
289 (δ_i). Throughout the analysis, we cluster the standard errors at the industry-year pair to
290 account for the potential correlation between errors within each industry over time.

Table 2: The effect of tariffs on markdowns: Baseline results.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable = log(markdown)						
Sample period: 2000–2006						
Input tariff	0.144*** (0.033)		0.125*** (0.037)	0.222*** (0.042)		0.246*** (0.047)
Output tariff		0.057*** (0.013)	0.023 (0.015)		0.038** (0.016)	-0.025 (0.019)
lagged log(markup)				0.042*** (0.008)	0.041*** (0.008)	0.042*** (0.008)
Observations	774,159	774,159	774,159	408,703	408,703	408,703
Adjusted R-squared	0.977	0.977	0.977	0.979	0.979	0.979

Notes: All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

291 Table 2 shows that larger tariff reductions are associated with significantly lower mark-
292 downs across firms in China. Column 1 suggests that a reduction of tariffs from 30 percent
293 to 10 percent has led to a decrease in markdowns by approximately 3 ($=20 \times 0.144$) percent,
294 all else equal. Column 2 looks at the effect of output tariffs and the estimate on output tariffs
295 is also positive and statistically significant. Column 3 includes both input tariffs and output
296 tariffs in the regression. The estimated coefficient on output tariffs loses statistical signifi-
297 cance once input tariffs are controlled for, suggesting that the effect of trade liberalization
298 on labor markdowns works primarily through input tariff reductions. Columns 4 to 6 show
299 that the result is not driven by changes in the distortion within the output market. Recall
300 that the markdown is measured as the ratio of two markups: the labor-based markup and
301 the materials-based markup, with the latter reflecting the distortion in the output market.

302 Therefore, an increase in the output market distortion would mechanically cause a decrease
303 in our measured markdown. Columns 4 to 6 add one-period lagged log markups as an addi-
304 tional control in the regression. Input tariff reductions continue to be associated with lower
305 markdowns after including lagged markups.¹³

306 One may be concerned that trade liberalization affects not just labor market power but
307 also the monopsony power in raw materials. An increase in materials market monopsony
308 power, after trade liberalization—say due to more potential sellers, would bias upward our
309 results. We therefore look at the robustness of the results across firms exposed to different
310 degree of concentration in the market for materials. In the Appendix, in Table A.13, we
311 interact the input tariffs with firms’ share of imported inputs or the concentration of imported
312 input market. We find no evidence that higher pre-reform firm share in the market for
313 imported materials explains the decline in labor markdowns after trade liberalization. Table
314 A.13 shows that the newly added interaction terms have no significant effect on the dynamics
315 of labor markdowns, even though they are negative.

316 Table 3 suggests that the effect of trade liberalization is driven mainly by long-term
317 changes in tariffs and labor markdowns. In Table 3, we estimate time-difference regressions
318 with lags ranging from one year to five years. This approach allows us to control for latent
319 heterogeneity in the panel data, and further reduces omitted variable bias concerns. We
320 find that the one-year and two-year changes in input tariffs are not significantly associated
321 with markdown changes over the same period. In contrast, lower input tariffs significantly
322 decrease labor markdowns using three-to-five-year difference estimators.

323 The results above show that Chinese manufacturing firms exposed to larger input tariffs
324 reductions had significantly lowers labor markdowns in their labor markets.

¹³Controlling for contemporaneous markups in the regression is problematic because markup also responds to changes in tariffs (see the discussion of “bad controls” in Angrist and Pischke, 2009.) In the following analyses, we stop presenting the results with only output tariffs since Table 2 suggests that the effect of trade liberalization on markdowns is driven mainly by input tariff variations.

Table 3: The effect of tariffs on markdowns: Difference estimator.

	(1)	(2)	(3)	(4)	(5)
Dependent variable = $\Delta\log(\text{markdown})$					
Sample period: 2000–2006					
	1-year	2-year	3-year	4-year	5-year
Δ Input tariff	0.032 (0.028)	0.051 (0.038)	0.122*** (0.044)	0.131** (0.051)	0.107* (0.060)
Δ Output tariff	0.023** (0.011)	0.020 (0.018)	0.025 (0.020)	0.021 (0.024)	0.031 (0.031)
Observations	511,072	300,720	198,498	120,570	68,119
Adjusted R-squared	0.897	0.906	0.911	0.914	0.917

Notes: All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics (total output, size of employment, capital-labor ratio, and total labor payments). The regression also controls for one-period-lagged markup. The firm-level characteristics and markup enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

3.2.2. Role of Skill Intensity

The literature suggests that trade liberalization increases the wage gap between high-skill and low-skill workers (Attanasio, Goldberg and Pavcnik, 2004; Verhoogen, 2008; Chen, Yu and Yu, 2017; Han, Liu and Zhang, 2012), implying that trade-induced markdown changes may also contribute to income inequality. In this subsection, we test whether the impact of trade liberalization on markdowns differs across a firm’s skill intensity. The regression specification we use is as follows:

$$\log(\mu_{ist}) = \alpha_1 \text{tariff}_{st} + \alpha_2 \text{tariff}_{st} \times \mathbb{1}\{\text{skill intensive}\}_i + \mathbf{X}_{ist}\beta + \delta_t + \delta_s + \delta_i + \epsilon_{ist}, \quad (14)$$

332 where $\mathbb{1}\{\text{skill intensive}\}_i$ is a variable indicating whether firm i is skill intensive. The indi-
333 cator of skill-intensive firms is based on the fraction of employees who completed college.
334 $\mathbb{1}\{\text{skill intensive}\}_i$ is equal to 1 if the fraction of college-educated employees at firm i is higher
335 than the average fraction of college-educated employees across all firms in the same 2-digit
336 industry.¹⁴ The markdown at skill-intensive firms may have evolve differently compared
337 with that of non-skill-intensive firms. We allow for this by interacting the skill-intensive firm
338 indicator with time fixed effects and including these interaction terms as additional controls.

339 Table 4 shows the results from examining the potentially heterogeneous effects of trade
340 liberalization on markdowns across a firm’s skill intensity. Columns 1 and 2 regress mark-
341 downs on tariffs and the interaction term of tariffs with the skill-intensive indicator. We
342 find that the estimated coefficients on the interaction terms are significantly positive. It
343 suggests that compared to non-skill-intensive firms, skill-intensive firms reduce markdowns
344 significantly more after trade liberalization. Columns 3 and 4 add one-period lagged log
345 markups as an additional control in the regression. We find that the estimated coefficient
346 on the interaction term is still significantly positive. Altogether, these results show that the
347 reduction of labor markdowns caused by input trade liberalization is significantly larger for
348 skill-intensive firms.¹⁵

¹⁴The information about employees’ education level is available only in the 2004 CIE data. Therefore, our measure of a firm’s skill intensity is time-invariant. This also precludes us from having a time-varying measure of the skill premium at the firm level.

¹⁵We conduct robustness tests on the results in Table 4, using alternative cutoffs for skill-intensive firms. We consider a firm skill-intensive if the fraction of college-educated employees at the firm is higher than the 60th percentile or the 70th percentile of the distribution of the fraction of college-educated employees across all firms with the same 2-digit industry code. Our results are not sensitive to the cutoff used.

Table 4: Effect of trade liberalization on markdowns and skill intensity.

	(1)	(2)	(3)	(4)
Dependent Variable = log(markdown)				
Sample period: 2000–2006				
Input tariff	0.127***	0.112***	0.156***	0.178***
	(0.035)	(0.040)	(0.048)	(0.054)
Input tariff $\times \mathbb{1}\{\text{skill intensive}\}$	0.073**	0.076**	0.134***	0.130***
	(0.032)	(0.032)	(0.044)	(0.044)
Output tariff		0.017		-0.021
		(0.016)		(0.021)
lagged log(markup)			0.025***	0.025***
			(0.008)	(0.008)
Observations	662,147	662,147	360,531	360,531
Adjusted R-squared	0.978	0.978	0.979	0.979

Notes: This table presents the estimates from Equation (14). All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

349 We also find that the role of skill intensity on trade-induced lower markdowns is not
350 present for product markups. This exercise is particularly useful, since it further suggests
351 that the markdown effects we are documenting are not driven simply by changes in markups
352 in the output market. Specifically, we estimate Equations (13) and (14), replacing mark-
353 downs with markups as the dependent variable in the regressions.

Table 5: Effect of trade liberalization on markups and skill intensity.

	(1)	(2)	(3)	(4)
Dependent variable = log(markup)				
Sample period: 2000–2006				
Input tariff	-0.121***	-0.119***	-0.125***	-0.126***
	(0.021)	(0.024)	(0.023)	(0.027)
Input tariff $\times \mathbb{1}\{\text{skill intensive}\}$			-0.013	-0.013
			(0.021)	(0.022)
Output tariff		-0.002		0.000
		(0.011)		(0.012)
Observations	774,159	774,159	662,147	662,147
Adjusted R-squared	0.578	0.578	0.574	0.574

Notes: This table presents the estimates from Equation (13) and (14), replacing mark-downs with markups as the dependent variable. All regressions control for the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics (total output, size of employment, capital-labor ratio, and total labor payments). Columns 3 and 4 also include the interaction terms between the indicator for skill-intensive firms and time dummies. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

354 The results are reported in Table 5. Columns 1 and 2 show the effect of trade liberalization
355 on product markups. The results suggest that input trade liberalization is associated with
356 higher product markups. Columns 3 and 4 test the role of skill intensity by including the
357 interaction term of tariffs and the skill-intensive indicator in the regression. Skill intensity
358 does not play a significant role in explaining the variation in trade-induced product markups,
359 in contrast to trade-induced labor markdowns. In none of the regressions are the estimated
360 coefficients on the interaction term between tariffs and skill intensity indicator significantly
361 different from zero. Overall, this result suggests that while skill-intensive firms experience
362 a greater decline in markdowns during input trade liberalization, the increase in product
363 markups they experience is no greater than that of non-skill-intensive firms.

364 3.2.3. Robustness

365 We study the robustness of the baseline results to alternative specifications or measures of
366 markdowns, as well as additional controls, and report those results in [Appendix A](#).

367 *China’s Hukou System Reform* – One policy that affects China around the same time is
368 the reform of China’s Hukou system 1997–2002, which relaxed internal migration restrictions
369 especially for skilled workers. As this reform increases the number of available workers in the
370 local labor markets, it is possible that the reform has also reduced labor monopsony power.
371 We test the robustness of our results to the impact of Hukou reform using two different
372 kinds of regressions. First, we construct measures of migration costs following [Tombe and](#)
373 [Zhu \(2019\)](#) and include migration cost between all province-industry pairs as an additional
374 control in the regression.¹⁶ Table [A.1](#) and Table [A.2](#) show that higher migration costs predict
375 larger markdowns, but controlling for migration costs does not impact our results for trade
376 liberalization. Second, we divide the sample into two groups based on the inflow of migrants
377 in each province during 2000–2010. We find that the impact of tariffs on labor markdowns
378 is not statistically different between the two subsamples, suggesting that migration flows are
379 not driving the relationship between tariffs and markdowns (see Table [A.3](#) and Table [A.4](#)).

380 *Potential Endogeneity with Tariff Changes* – To account for potentially endogenous tariff
381 changes, we consider an alternative specification that explores the fact that trade liberaliza-
382 tion disproportionately impacted industries that initially had high tariffs. In the regression,
383 we replace contemporaneous tariff rates with the industry’s initial tariff level and its inter-
384 action with a post-WTO dummy. This approach alleviates the endogeneity concern because

¹⁶[Tombe and Zhu \(2019\)](#) show that the migration flow between two places can be written as a function of real wage differences and migration costs. Using migration patterns and real income level for each of China’s provinces, [Tombe and Zhu \(2019\)](#) estimate the migration costs for agricultural and non-agricultural workers between all province-sector pairs. We construct measures of migration costs for all province and 4-digit industry pairs based on the estimates from [Tombe and Zhu \(2019\)](#). Specifically, we use the paper’s estimates of between-province migration costs for non-agricultural workers and multiply them by each province’s distribution of employment across industries in 2000 to estimate province-industry specific migration costs. The assumption underlying our migration cost estimation is that the migration patterns between all province-industry pairs will mimic the distribution of employment across industries and provinces.

385 it is unlikely that the Chinese government predicted the future changes of various indus-
386 tries and used that information to negotiate tariff reductions upon entering the WTO. This
387 alternative regression points to the same conclusion as our baseline specification. We find
388 that industries experiencing greater input tariff reductions upon WTO accession showed a
389 larger markdown decline relative to the industries experiencing less input tariff reductions.
390 We also continue to find that the effect of input trade liberalization on labor markdowns is
391 larger for skill-intensive firms (see Tables [A.5](#) and [A.6](#), respectively).

392 *Alternative Markdown Measures* – We also consider using different approaches to mea-
393 suring markups in the construction of markdowns. As described in Section [3.1](#), one ap-
394 proach estimates markups using the gross profit margin, and the other approach estimates
395 the markups under the assumption that the production function is Cobb-Douglas. All the
396 regressions using different estimates of markdowns give qualitatively similar and compara-
397 ble results and confirm our main findings on the impact of input tariff reduction on labor
398 markdowns (see Table [A.7](#)) and the role of skill intensity (see Table [A.8](#)).

399 *Exporting Status* – We noted that the markdowns of exporting firms perhaps had a
400 differential time patterns compared with those of non-exporting firms. We allow for this
401 by creating a dummy for exporters and including its interaction with year dummies as
402 additional controls in the regressions. For some years, these exporter-specific time patterns
403 are significant, but our results for the effect of tariffs on markdowns and the role of skill
404 intensity do not qualitatively alter (see Tables [A.9](#) and [A.10](#)).

405 *Province-Specific Time Patterns* – Finally, we add province-time dummies as controls
406 to allow year-to-year variation to differ at the province level. The results, shown in Tables
407 [A.11](#) and [A.12](#), are virtually the same as the main findings in Section [3.2.1](#) and [3.2.2](#).

408 **3.3. Exploring a Potential Labor Supply Mechanism**

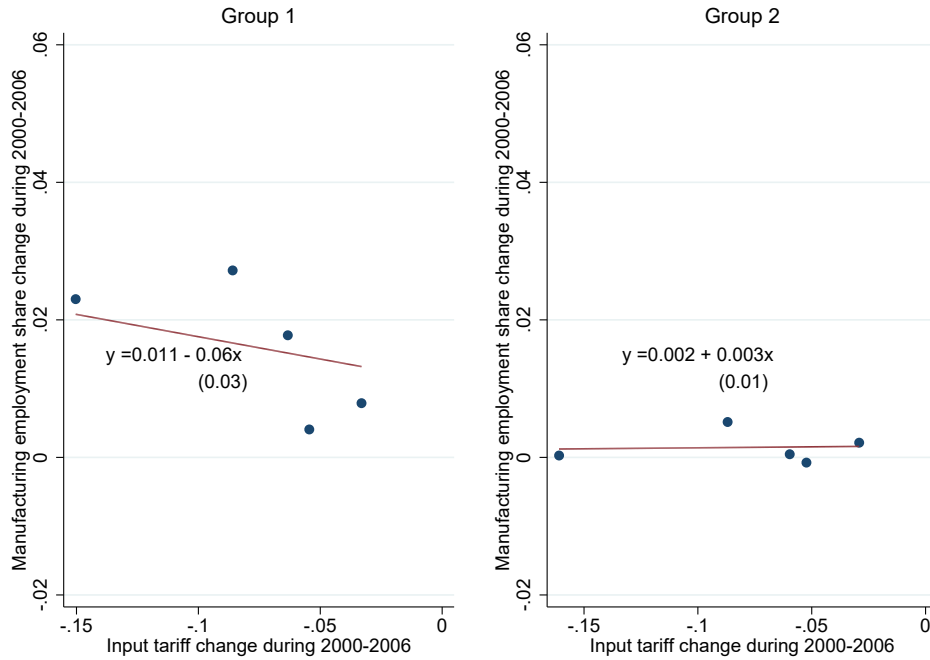
409 Our model predicts that the aggregate response to labor supply plays an important role in
410 explaining the response of labor markdowns to input trade liberalizations. In this section, we
411 present three pieces of evidence that are consistent with this mechanism. First, we show that
412 input tariff reductions decrease labor markdowns more in regions with larger aggregate labor
413 supply expansions. Second, we show that skill-intensive firms in industries that are more
414 geographically exposed to skilled labor supply growth through college expansion reforms
415 reduce markdowns more in response to tariff reductions. Finally, we find that larger firms,
416 measured using skilled labor market shares, experience a larger reduction in labor markdowns
417 in regions with greater expansion of the skilled labor supply.

418 **3.3.1. Labor Markdowns and Aggregate Labor Supply**

419 In this subsection, we test whether the response of labor markdowns to input trade liberal-
420 ization is influenced by changes in an area’s aggregate labor supply. We measure aggregate
421 labor supply in the local labor markets as the ratio of total manufacturing employment of
422 the labor market to the working-age population at the province level. To measure whether
423 the aggregate labor supply in a given province has expanded when input tariffs fell, for each
424 province separately, we regress the measure of aggregate labor supply on input tariffs for
425 that province.¹⁷ We then divide the provinces into two groups depending on whether the
426 estimated province-level “aggregate labor supply elasticity” coefficient with respect to input
427 tariffs is significantly negative.

¹⁷We also aggregate all the controls in the baseline regression to the labor market level and include them in the regression.

Figure 2: Manufacturing employment share adjustment and input tariff reduction.



Notes: The dots represent a binned scatter plot that partitions the data into five quintiles. The solid lines represent fitted values from regressing changes in manufacturing employment shares with respect to the working-age population on input tariff changes using all (non binned) observations. The changes of the variable are computed as the difference between the variable's value in 2006 and its value in 2000.

428 Figure 2 plots the change in aggregate labor supply between 2000 and 2006 on the change
429 in input tariffs over the same period for the two groups of provinces. Group 1 includes the
430 provinces that experienced a significant increase in aggregate labor supply following input
431 trade liberalization. The graph suggests that on average, the aggregate labor supply increases
432 by 0.6 percent for an extra 10 percent decrease in input tariffs. Group 2 includes the provinces
433 that had no significant increase in aggregate labor supply. The graph shows that for these
434 provinces, the change in aggregate labor supply between 2000 and 2006 is not significantly
435 correlated with the change in input tariffs over the same period.

Table 6: The effect of tariffs on markdowns: Aggregate labor supply adjustments.

	(1)	(2)	(3)	(4)
Dependent variable = log(markdown)				
Sample period = 2000–2006				
	Group 1	Group 2	Group 1	Group 2
Input tariff	0.181*** (0.035)	0.117*** (0.037)	0.162*** (0.040)	0.099** (0.041)
Output tariff			0.028 (0.019)	0.020 (0.017)
Observations	454,840	319,316	454,840	319,316
Adjusted R ²	0.979	0.975	0.979	0.975

Notes: This table presents the estimates of Equation (13) using firms from two groups of provinces. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

436 Our model predicts that input tariff reductions lower labor markdowns if and only if
437 the aggregate labor supply increases enough. Therefore, we tested whether the impact of
438 input trade liberalization on labor markdowns is different for firms that belong to these two
439 groups. Table 6 shows that aggregate labor supply adjustments have played an important role
440 in explaining the effect of input tariff reductions on labor markdowns. Column 1 shows that
441 a 10 percent reduction in input tariffs decreased markdowns by approximately 1.8 percent
442 for firms that experienced a significant increase in aggregate labor supply. Column 2 shows
443 that the effect of tariffs on markdowns drops to approximately 1.2 percent when we look at
444 firms which did not experience an increase in aggregate labor supply. The difference between
445 the estimates in Columns 1 and 2 is statistically significant. Columns 3 and 4 show that this
446 general pattern of tariff effect across the two groups is repeated even when output tariffs are

447 included. Overall, the results suggest that input tariff reductions significantly lower labor
448 markdowns in areas with larger aggregate labor supply expansions.

449 **3.3.2. College Expansion Shocks**

450 The previous results suggest that the adjustment of the aggregate labor supply is important
451 to explain the response of labor markdowns to input trade liberalization. However, one may
452 be concerned that changes in aggregate labor supply are not exogenous and may correlate
453 with other changes in the labor market. In this subsection, we test the model predictions by
454 utilizing an exogenous shock to the aggregate supply of skilled labor in China: the dramatic
455 expansion of higher education that started in 1999.

456 In order to rejuvenate the economy in the wake of the Asian financial crisis, in June 1999,
457 the central government of China made a decision to expand the scale of higher education.
458 The expansion led to a dramatic increase in college enrollment throughout the country. The
459 annual college recruitment in regular higher education institutions was less than 1 million
460 students in 1997, gradually increasing from around 500,000 students in 1990. After the
461 expansion in 1999, college recruitment sharply rose and steadily grew, exceeding 5 million
462 by 2006 (Wang, 2014).

463 We exploit the differential exposure to the college expansion across industries to identify
464 the effect of skilled labor supply expansion on the markdown response to input tariff reduc-
465 tions. For each industry, we construct a Bartik-style measure of the college expansion shock
466 by interacting provincial shares of skilled labor with the provincial growth rates of college
467 graduates. The expression of the shock is as follows:

$$\text{expansion shock}_{st} = \sum_k z_{sk} g_{kt},$$

468 where s indexes the 4-digit industry, k indexes the province, z_{sk} is the provincial share of
469 skilled labor from the industry, and g_{kt} represents the growth rate of college graduates. We

470 fix the provincial shares of skilled labor to 2004, which is the year for which the information
 471 on skilled labor is available. Since college expansion may be correlated with labor market
 472 changes inside the province that affect labor markdowns, we instrument for the college
 473 expansion in province k using the college expansion in other provinces. Specifically, we let
 474 expansion shock $_{st} = \sum_k z_{sk} \hat{g}_{kt}$ and $\hat{g}_{kt} = g_{-k,t}$ where $g_{-k,t}$ denotes the growth rate of college
 475 graduates in all provinces excluding province k .¹⁸

476 To test whether the expansion of skilled labor affects the impact of input trade liberaliza-
 477 tion on labor markdowns, we modify the regression to include an interaction term between
 478 the tariffs and the expansion shock:

$$\log(\mu_{ist}) = \alpha_1 \text{tariff}_{st} + \alpha_2 \text{tariff}_{st} \times \text{expansion shock}_{st} + \mathbf{X}_{ist} \beta + \delta_t + \delta_s + \delta_i + \epsilon_{ist}. \quad (15)$$

479 The regression coefficient α_2 tells us whether differential exposure to college expansion shocks
 480 leads to differential responses of labor markdowns to trade liberalization.

481 Table 7 shows the results from estimating equation 15. The results suggest that the
 482 increase in the aggregate supply of skilled labor due to college expansion amplified the effect
 483 of trade liberalization on labor markdowns. Column 1 shows the results using all firms in
 484 the sample. We find that firms that experienced a larger increase in the supply of skilled
 485 labor reduced markdowns more after trade liberalization. Column 2 restricts the sample
 486 to skill-intensive firms, for which the effect of college expansion on the markdown response
 487 is even stronger. Columns 3 and 4 show that the result is robust to adding output tariffs
 488 into the regression. Overall, the analysis using the exogenous shock to skilled labor supply
 489 also suggests that the impact of input tariff reductions on labor markdowns is influenced by
 490 changes in aggregate labor supply.

¹⁸In the appendix Table A.14, we show the results about college expansion without using the instrument. The estimated coefficients are very similar to the ones in the main text (see Table 7).

Table 7: Effect of tariffs on markdowns with skill intensity and college expansion

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
	Sample period = 2000–2006			
	All	Skill- intensive	All	Skill- intensive
Input tariffs	0.133*** (0.033)	0.181*** (0.041)	0.112*** (0.037)	0.156*** (0.044)
Input tariffs × expansion shock	0.139* (0.076)	0.254** (0.102)	0.147* (0.077)	0.260** (0.103)
Output tariffs			0.025* (0.015)	0.034 (0.023)
Observations	774,159	319,803	774,159	319,803
Adjusted R-squared	0.977	0.977	0.977	0.977
1st-stage F statistics	147.13	147.13	147.13	147.13
Mean of expan shock	0.251	0.251	0.251	0.251

Notes: This table presents the estimates from Equation (15). All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

491 3.3.3. Skilled Labor Supply Expansion and Labor Market Share

492 We now more closely explore the impact of tariffs on labor markdowns in regions with college
493 expansion reforms. In particular, we compute a measure of firm size that consists of its share
494 of local skilled labor force and analyze the interaction between firm size, trade-induced labor
495 markdown reduction, and aggregate supply of skilled labor. The results are presented in
496 Table 8.

Table 8: Effect of tariffs on markdowns with skilled labor market share and college expansion

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable = log(markdown)						
Sample period: 2000–2006						
	All		High expansion areas		Low expansion areas	
Input tariffs	0.174***	0.206***	0.135***	0.158***	0.226***	0.263***
	(0.035)	(0.042)	(0.033)	(0.037)	(0.046)	(0.056)
Input tariffs × Firm’s share (province)	-0.134*		-0.034		-0.228***	
	(0.069)		(0.078)		(0.084)	
Input tariffs × Firm’s share (city)		-0.112**		-0.070		-0.150***
		(0.044)		(0.045)		(0.056)
Observations	434,330	408,195	209,923	194,220	224,406	213,974
Adjusted R-squared	0.977	0.978	0.977	0.978	0.977	0.977

Notes: This table estimates the effect of tariffs on labor markdowns and its relationship with firms’ share of skilled labor in the local labor market. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

497 Focusing on Columns 1 and 2, we find that compared with those of small firms, the labor
498 markdowns of large firms are significantly less affected by input tariff reductions. This result
499 is consistent with the existing theory that suggests that firm size is substantially associated
500 with the ability to exercise monopsony power in the local labor market.¹⁹ Moreover, the
501 results continue to show that the impact of tariff reductions on labor markdowns exhibits

¹⁹For example, Brooks et al. (2021b) show that labor markdowns are positively correlated with the firm’s labor market share. Here, we focus on firms’ market share in the skilled labor market, since we want to analyze the impact of college expansion reform on the exercise of monopsony power in the skilled labor market.

502 different patterns across regions with varying degrees of college expansion reforms. Columns
503 3 and 4 show the behavior of firms in provinces that experienced a large college expansion.
504 In those high expansion areas, input tariff reductions led to a significant decrease in labor
505 markdowns for small and large firms, and the impact on large firms is statistically indistin-
506 guishable from that on small firms. In contrast, when we focus on areas that experienced
507 a small college expansion (Columns 5 and 6), we see that the impact of tariff reductions
508 is concentrated on small firms, and the impact on large firms is significantly smaller and
509 close to zero when firm sizes are measured at the province level. Overall, the results suggest
510 that markdowns fell more for large firms located in regions that experienced larger college
511 expansion reforms. The results support the model’s predictions that aggregate labor supply
512 expansion plays an important role in explaining the change in labor markdowns following
513 input trade liberalization.

514 **4. Aggregate Implications of Labor Markdown Changes**

515 In this section, we investigate the change in aggregate labor share that arises from the
516 impact of trade liberalization on labor markdowns. We also look at the contribution of
517 trade liberalization to the evolution of the wage premium at skill-intensive firms through
518 differential trade-induced changes in labor markdowns at skill-intensive firms.

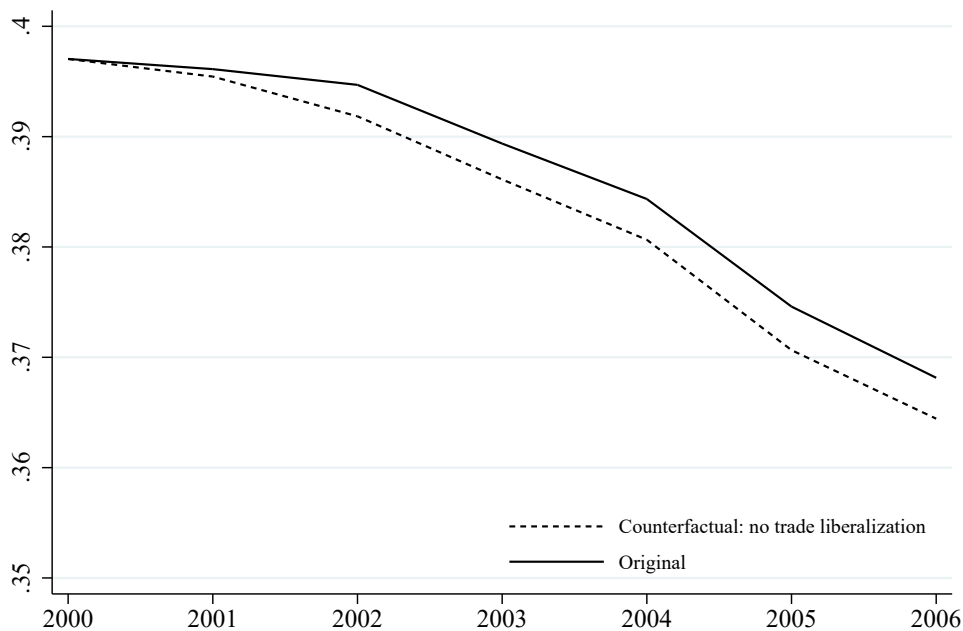
519 **4.1. Aggregate Labor Share Dynamics**

520 We calculate the counterfactual labor share using the formula provided in [Brooks et al.](#)
521 [\(2021b\)](#). [Brooks et al. \(2021b\)](#) show that the reciprocal of the labor share can be expressed
522 as an equation of labor markdowns, product markups, and output elasticities with respect to
523 materials and labor. To compute the counterfactual labor share, we replace the actual labor
524 markdowns with the counterfactual labor markdowns that would happen in the absence of

525 trade liberalization. See [Appendix E](#) for more details.

526 Figure 3 shows the actual and counterfactual labor share in Chinese manufacturing sec-
527 tor. The solid line shows the actual aggregate labor share in the data. The labor share in
528 China decreases by approximately 3 percentage points between 2000 and 2006. The dotted
529 line shows the counterfactual aggregate labor share in the absence of trade-driven markdown
530 changes. The results suggest that if labor markdowns were not reduced due to trade liberal-
531 ization, aggregate labor share would decrease by 0.4 percentage point (or 13 percent) more
532 at the end of 2006.

Figure 3: Aggregate Labor Share in Manufacturing
Observed and Counterfactual



Notes: This graph plots the time path of aggregate labor's value-added share in the data, and counterfactual labor share in the absence of trade-driven markdown changes.

533 4.2. Skill-Intensive Firm Wage Premium

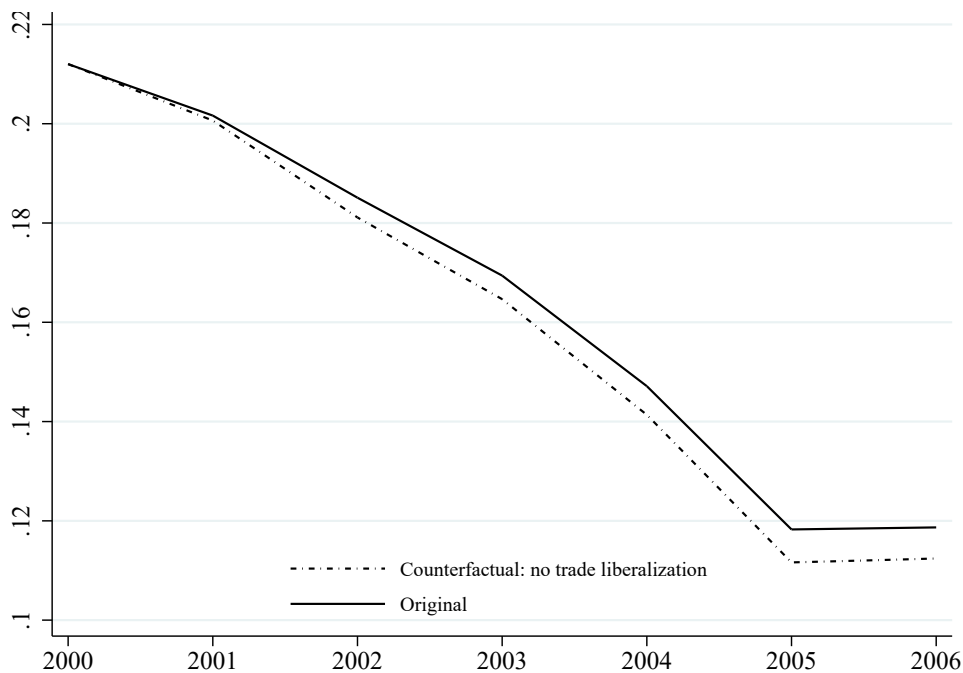
534 The results in Section 3.2.2 show that trade liberalization has differential impact on labor
535 markdowns for skill-intensive and non-skill-intensive firms. This subsection estimates the

536 change in the wage premium for skill-intensive firms that is explained by trade liberalization.

537 We calculate the wage premium by comparing the average wage of skill-intensive firms to
538 that of non-skill-intensive firms. We regress the average wage on an indicator of skill-intensive
539 firms and a large set of variables controlling for firm-specific characteristics.²⁰ We interpret
540 the coefficient on the skill-intensive dummy as an estimate of wage premium of skill-intensive
541 firms. To compute counterfactual wage premium in the absence of trade liberalization, we
542 keep the marginal revenue product of labor unchanged, and only focus on the component of
543 the wage premium driven by the change in labor markdowns of skill-intensive firms relative
544 to labor markdowns of non-skill-intensive firms.

²⁰We show the regression estimates in appendix Table E.1. In addition to the skill-intensive dummy, the regression includes 2-digit industry-by-year fixed effect, location-by-industry fixed effects, firm fixed effect, and time-varying firm characteristics such as output and exporting status. Our estimates of wage premium change very little if we include exporter-by-year fixed effects.

Figure 4: Wage Premium for Skill-Intensive Firms
Observed and Counterfactual



Notes: This graph plots the log wage difference between skill-intensive and non-skill-intensive firms after controlling for industry fixed effects, year fixed effects, location fixed effects, and time-varying firm characteristics. The solid line represents the time path of the skilled wage premium in the data. The dotted line represents the counterfactual wage premium where we assume the reduction in labor markdowns after trade liberalization for skill-intensive firms is the same as the reduction in labor markdowns for non-skill-intensive firms.

545 Figure 4 shows the actual and counterfactual wage premium for skill-intensive firms. In
 546 2000, the average wage of skill-intensive firms is about 20 percent higher than the average
 547 wage of non-skill-intensive firms. This gap shrinks over time: By the end of the sample
 548 period, the wage premium for skill-intensive firms has declined to about 12 percent. The
 549 dotted line shows the counterfactual wage premium if trade liberalization reduces labor
 550 markdowns by the same amount for skill-intensive and non-skill-intensive firms: The wage
 551 premium at skill-intensive firms would have further decrease to almost 11 percent by 2006.
 552 Therefore, the reduction in wage premium between 2000 and 2006 would be larger, by 0.7
 553 percentage points, in the absence of trade-induced markdown changes.

554 5. Conclusion

555 How does input trade liberalization affect firms' monopsony power in labor markets? We
556 develop a simple model to trace how endogenous labor markdown changes after input tariff
557 reductions, and to guide our empirical investigations. Our model shows that input tariff
558 reductions lower firms' labor monopsony power if the aggregate labor supply expands enough
559 to offset the labor concentrating effect of increased labor demand from incumbent firms.

560 Consistent with this labor supply elasticity mechanism, we show that following China's
561 entry in the WTO and the ensuing input trade liberalization, firms labor markdowns are
562 lower in labor markets with larger tariff reductions, especially for larger skill-intensive firms
563 in locations where the aggregate labor of college-educated workers expand more.

564 Our results highlight the role of heterogeneous labor supply responses and skill intensity
565 when considering the labor monopsony impact of trade reforms. One key caveat of our
566 analysis is that we effectively take labor supply changes as given. Future research could
567 fully endogenize labor supply decisions, along with rich labor supply elasticity heterogeneity
568 when examining the effect of trade reforms on labor market power. This may be particularly
569 important direction given the emerging divergence between findings in China and Brazil.

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Appendix A. Appendix: Tables for Robustness Checks

Table A.1: Migration costs and the impact of trade liberalization

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
Input tariffs	0.147*** (0.033)	0.130*** (0.037)	0.223*** (0.041)	0.250*** (0.047)
Output tariffs		0.020 (0.015)		-0.028 (0.018)
lagged log(markup)			0.042*** (0.008)	0.042*** (0.008)
log(migration cost)	0.012*** (0.002)	0.012*** (0.002)	0.011*** (0.002)	0.011*** (0.002)
Firm characteristics	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	771,326	771,326	407,378	407,378
Adjusted R-squared	0.977	0.977	0.979	0.979

Notes: This table presents the estimates from Equation (13) including migration costs as an additional control in the regression. The migration cost is estimated following Tombe and Zhu (2019), and we include the log of the migration cost in the regression. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.2: Migration costs and the impact of trade liberalization

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
Input tariffs	0.130*** (0.034)	0.119*** (0.040)	0.156*** (0.047)	0.182*** (0.053)
Output tariffs		0.012 (0.016)		-0.025 (0.021)
lagged log(markup)			0.025*** (0.008)	0.025*** (0.008)
Input tariffs $\times \mathbb{1}_{\text{skill intensity}}$	0.072** (0.032)	0.074** (0.032)	0.139*** (0.044)	0.133*** (0.044)
log(migration cost)	0.012*** (0.002)	0.012*** (0.002)	0.011*** (0.002)	0.011*** (0.002)
Firm characteristics	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	659,729	659,729	359,350	359,350
Adjusted R-squared	0.978	0.978	0.979	0.979

Notes: This table presents the estimates from Equation (14) including migration costs as an additional control in the regression. The migration cost is estimated following Tombe and Zhu (2019), and we include the log of the migration cost in the regression. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.3: Migration flows and the impact of trade liberalization

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
	Low migration inflow changes	Low migration inflow changes	High migration inflow changes	High migration inflow changes
Input tariffs	0.100*** (0.037)	0.246*** (0.045)	0.199*** (0.054)	0.260*** (0.076)
Output tariffs	0.025 (0.015)	-0.026 (0.017)	0.024 (0.026)	-0.014 (0.036)
lagged log(markup)		0.065*** (0.008)		0.005 (0.011)
Firm characteristics	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	470,300	248,513	303,853	160,184
Adjusted R-squared	0.976	0.978	0.978	0.981

Notes: This table presents the estimates from Equation (13) using two subsamples. Columns 1 and 2 show the results using provinces with below-median migration inflows in 2000. Columns 3 and 4 show the results using provinces with above-median migration inflows. The change in migration inflows is calculated as the total inflow migrants in 2010 minus the total inflow migrants in 2000 divided by the population in 2000. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.4: Migration flows and the impact of trade liberalization

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
	Low migration inflow changes	Low migration inflow changes	High migration inflow changes	High migration inflow changes
Input tariffs	0.096** (0.039)	0.178*** (0.052)	0.161** (0.065)	0.203** (0.094)
Output tariffs	0.015 (0.016)	-0.024 (0.020)	0.026 (0.028)	-0.007 (0.039)
Input tariffs * 1skill intensity	0.077* (0.040)	0.137** (0.053)	0.068 (0.049)	0.101 (0.071)
lagged log(markup)		0.046*** (0.008)		-0.008 (0.011)
Firm characteristics	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Observations	391,558	214,062	270,585	146,463
Adjusted R-squared	0.977	0.978	0.979	0.981

Notes: This table presents the estimates from Equation (14) using two subsamples. Columns 1 and 2 show the results using provinces with below-median migration inflows in 2000. Columns 3 and 4 show the results using provinces with above-median migration inflows. The change in migration inflows is calculated as the total inflow migrants in 2010 minus the total inflow migrants in 2000 divided by the population in 2000. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.5: The effect of tariffs on markdowns: difference-in-difference estimation

	(1)	(2)	(3)	(4)
Dependent variable = log(markdown)				
Sample period: 2000–2006				
Input tariff ₂₀₀₀	0.018	-0.002	0.028	0.018
	(0.034)	(0.036)	(0.046)	(0.046)
Input tariff ₂₀₀₀	-0.049***	-0.049***	-0.057***	-0.057***
× $\mathbb{1}\{\text{post-WTO dummy}\}$	(0.015)	(0.015)	(0.021)	(0.022)
Output tariff ₂₀₀₀		0.027		0.016
		(0.019)		(0.024)
lagged log(markup)			0.042***	0.042***
			(0.008)	(0.008)
Observations	774,159	774,159	408,703	408,703
Adjusted R-squared	0.977	0.977	0.979	0.979

Notes: All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.6: The effect of tariffs on markdowns: difference-in-difference estimation

	(1)	(2)	(3)	(4)
	Dependent Variable = $\log(\text{markdown})$			
	Sample period: 2000–2006			
	Skill-intensive	Non-skill intensive	Skill-intensive	Non-skill intensive
Input tariff ₂₀₀₀	0.043 (0.046)	-0.017 (0.062)	0.050 (0.058)	0.035 (0.091)
Input tariff ₂₀₀₀ $\times \mathbb{1}\{\text{post-WTO dummy}\}$	-0.080*** (0.021)	-0.042* (0.022)	-0.103*** (0.030)	-0.041 (0.033)
Output tariff ₂₀₀₀	0.056* (0.030)	-0.005 (0.030)	0.082** (0.033)	-0.062 (0.043)
lagged $\log(\text{markup})$			0.012 (0.009)	0.045*** (0.010)
Observations	319,803	341,488	180,941	178,838
Adjusted R-squared	0.977	0.979	0.979	0.979

Notes: All regressions control for the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics (total output, size of employment, capital-labor ratio, and total labor payments). The regressions also include an interaction term between the indicator for skill-intensive firms and time dummies. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.7: The effect of tariffs on markdowns: alternative measures of markdowns

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable = log(markdown)					
	Sample period: 2000–2006					
	DLW (baseline)	CD	CRS	DLW	CD	CRS
Input tariffs	0.125*** (0.037)	0.098*** (0.030)	0.058** (0.029)	0.246*** (0.047)	0.209*** (0.039)	0.166*** (0.032)
Output tariff	0.023 (0.015)	0.018 (0.013)	0.015 (0.012)	-0.025 (0.019)	-0.025 (0.016)	-0.030** (0.013)
lagged log(markup)				0.042*** (0.008)	0.056*** (0.008)	0.041*** (0.006)
Observations	774,159	774,159	774,159	408,703	408,703	408,703
Adjusted R-squared	0.977	0.977	0.976	0.979	0.979	0.978

Notes: The regressions estimate the effect of tariffs on markdowns using different measures of markdowns. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.8: The role of skill intensity: alternative measures of markdowns

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable = log(markdown)					
	Sample period: 2000–2006					
	DLW (baseline)	CD	CRS	DLW	CD	CRS
Input tariffs	0.112*** (0.040)	0.095*** (0.034)	0.077** (0.030)	0.178*** (0.054)	0.181*** (0.054)	0.176*** (0.053)
Input tariff $\times \mathbb{1}\{\text{skill intensive}\}$	0.076** (0.032)	0.056* (0.032)	0.022 (0.031)	0.130*** (0.044)	0.129*** (0.044)	0.126*** (0.044)
Output tariff	0.017 (0.016)	0.008 (0.014)	0.000 (0.012)	-0.021 (0.021)	-0.022 (0.021)	-0.022 (0.021)
lagged log(markup)				0.025*** (0.008)	0.037*** (0.008)	0.054*** (0.006)
Observations	662,147	662,147	662,147	360,531	360,531	360,531
Adjusted R-squared	0.978	0.978	0.977	0.979	0.979	0.979

Notes: The regressions estimate the effect of tariffs on markdowns using different measures of markdowns. All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. The regressions also include an interaction term between the indicator for skill-intensive firms and time dummies. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.9: The effect of tariffs on markdowns controlling for exporter-specific secular trends

	(1)	(2)	(3)	(4)
Dependent Variable = log(markdown)				
Sample period: 2000–2006				
Input tariffs	0.144*** (0.030)	0.131*** (0.035)	0.221*** (0.039)	0.249*** (0.045)
Output tariffs		0.017 (0.014)		-0.029* (0.017)
lagged log(markup)			0.042*** (0.008)	0.042*** (0.008)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2000\}$	0.013*** (0.003)	0.013*** (0.003)		
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2001\}$	0.006** (0.003)	0.006** (0.003)	0.010*** (0.003)	0.010*** (0.003)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2002\}$	-0.004 (0.002)	-0.004 (0.002)	0.001 (0.003)	0.001 (0.003)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2003\}$	-0.002 (0.002)	-0.002 (0.002)	0.002 (0.002)	0.003 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2004\}$	-0.003 (0.002)	-0.003 (0.002)	0.000 (0.002)	0.000 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2005\}$	-0.004*** (0.001)	-0.004*** (0.001)	-0.002 (0.002)	-0.002 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2006\}$	-0.008*** (0.002)	-0.008*** (0.002)	-0.005** (0.002)	-0.005** (0.002)
Observations	774,156	774,156	408,702	408,702
Adjusted R-squared	0.977	0.977	0.979	0.979

Notes: All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.10: The role of skill intensity controlling for exporter-specific secular trends

	(1)	(2)	(3)	(4)
Dependent Variable = log(markdown)				
Sample period: 2000–2006				
Input tariffs	0.123*** (0.032)	0.115*** (0.037)	0.153*** (0.045)	0.181*** (0.050)
Input tariff $\times \mathbb{1}\{\text{skill intensive}\}$	0.079** (0.032)	0.080** (0.032)	0.140*** (0.044)	0.134*** (0.044)
Output tariffs		0.009 (0.015)		-0.027 (0.020)
lagged log(markup)			0.025*** (0.008)	0.025*** (0.008)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2000\}$	0.015*** (0.003)	0.015*** (0.003)		
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2001\}$	0.009*** (0.003)	0.008*** (0.003)	0.013*** (0.004)	0.013*** (0.004)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2002\}$	-0.004 (0.003)	-0.004 (0.003)	0.002 (0.003)	0.002 (0.003)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2003\}$	-0.001 (0.002)	-0.001 (0.002)	0.003 (0.002)	0.003 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2004\}$	-0.002 (0.002)	-0.002 (0.002)	0.001 (0.002)	0.001 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2005\}$	-0.004*** (0.001)	-0.004*** (0.001)	-0.002 (0.002)	-0.002 (0.002)
$\mathbb{1}\{\text{exporter}\} \times \mathbb{1}\{t=2006\}$	-0.008*** (0.002)	-0.008*** (0.002)	-0.005** (0.002)	-0.005** (0.002)
Observations	662,146	662,146	360,530	360,530
Adjusted R-squared	0.978	0.978	0.979	0.979

Notes: All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics. The regressions also include an interaction term between the indicator for skill-intensive firms and time dummies. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.11: The effect of tariffs on markdowns with province-specific secular trends

	(1)	(2)	(3)	(4)
Dependent Variable = log(markdown)				
Sample period: 2000–2006				
Input tariff	0.144*** (0.033)	0.134*** (0.037)	0.226*** (0.043)	0.256*** (0.048)
Output tariff		0.013 (0.015)		-0.030 (0.019)
lagged log(markup)			0.045*** (0.008)	0.045*** (0.008)
Province×Year FE	Yes	Yes	Yes	Yes
Observations	774,159	774,159	408,703	408,703
Adjusted R-squared	0.977	0.977	0.979	0.979

Notes: All regressions include firm-level characteristics, the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and the province-by-year fixed effect. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.12: The role of skill intensity with province-specific secular trends

	(1)	(2)	(3)	(4)
Dependent variable = $\log(\text{markdown})$				
Sample period: 2000–2006				
Input tariff	0.126*** (0.034)	0.121*** (0.040)	0.158*** (0.049)	0.187*** (0.055)
Input tariff $\times \mathbb{1}\{\text{skill intensive}\}$	0.075** (0.032)	0.076** (0.033)	0.138*** (0.045)	0.132*** (0.045)
Output tariff		0.005 (0.016)		-0.028 (0.022)
lagged $\log(\text{markup})$			0.028*** (0.008)	0.028*** (0.008)
Province \times Year FE	Yes	Yes	Yes	Yes
Observations	662,147	662,147	360,531	360,531
Adjusted R-squared	0.978	0.978	0.978	0.978

Notes: This table presents the estimates from equation (14). All regressions control for the time fixed effect, the 2-digit CIC sector/industry fixed effect, the firm fixed effect, and firm-level characteristics (total output, size of employment, capital-labor ratio, and total labor payments). The regressions also include an interaction term between the indicator for skill-intensive firms and time dummies. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.13: Imported input intensity and the impact of trade liberalization

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
	All	2001–2006	2001–2006	2001–2006
Input tariffs	0.125*** (0.037)	0.209*** (0.046)	0.217*** (0.056)	0.220*** (0.048)
Output tariffs	0.023 (0.015)	-0.005 (0.017)	-0.006 (0.017)	-0.006 (0.017)
Input tariffs × lagged imported input HHI			-0.019 (0.046)	
Input tariffs × lagged imported input share				-0.789 (0.495)
Firm-level characteristics	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	774,159	692,181	692,178	692,178
Adjusted R-squared	0.977	0.978	0.978	0.978

Notes: This table tests whether the effect of input trade liberalization on labor markdowns varies with the firms' presence in imported input markets. We measure the firm's presence in imported input markets using the concentration in its imported input market (columns 1 and 2) or its imported input share (columns 3 and 4). All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

Table A.14: Effect of tariffs on markdowns with skill intensity and college expansion

	(1)	(2)	(3)	(4)
	Dependent variable = log(markdown)			
	Sample period = 2000–2006			
	All	Skill- intensive	All	Skill- intensive
Input tariff	0.129*** (0.032)	0.171*** (0.041)	0.107*** (0.037)	0.145*** (0.044)
Input tariff × expansion shock	0.161** (0.080)	0.304*** (0.108)	0.171** (0.079)	0.310*** (0.108)
Output tariff			0.026* (0.015)	0.035 (0.023)
Observations	774,159	319,803	774,159	319,803
Adjusted R ²	0.977	0.977	0.977	0.977
Mean of expan shock	0.244	0.244	0.244	0.244

Notes: This table presents the estimates from Equation (15). All regressions include the time fixed effect, the 2-digit CIC sector/industry fixed effect, and the firm fixed effect. The regressions also control for firm-level characteristics including total output, size of employment, capital-labor ratio, and total labor payments. These variables enter the regression in logarithms. Robust standard errors clustered at the industry-year pair are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.

676 Appendix B. Appendix: Markdown Measurements

677 In this appendix, we describe the steps we take to construct measurements of markups and
678 markdowns. To construct measures of markups, we adopt the approach suggested by [de](#)
679 [Loecker and Warzynski \(2012\)](#), which builds upon the insights from [Hall \(1987\)](#). [de Locker](#)
680 and [Warzynski](#) show that the markup for firm i at time t can be expressed as

$$\mu_{it} = \frac{\theta_{it}^M}{\alpha_{it}^M},$$

681 where M indicates any flexibly chosen, price-taking input, θ_{it} is the output elasticity on input
682 M , and α_{it} is the share of output revenue spent on input M . We follow the IO literature
683 and assume materials as the flexible-chosen inputs. We directly compute the factor payment
684 share α_{it} using our production data, since the data contain detailed firm-level information,
685 including gross output and material expenditures.²¹ To estimate the output elasticity of
686 materials, we use the production function estimation of [Akerberg, Caves and Frazer \(2015\)](#),
687 as in [de Loecker and Warzynski \(2012\)](#). First, we estimate a polynomial regression of logged
688 output and obtain a nonparametric estimate of logged output free of measurement error.
689 Then, we construct measures of productivity under the assumption of a 3rd-order translog
690 specification of gross output. Finally, we estimate all coefficients in the production function
691 by relying on the law of motion for productivity. The output elasticity of materials is
692 computed based on the estimated coefficients of the production function.

693 Although the above approach for estimating markups is standard in the IO literature (see
694 [de Loecker and Eeckhout, 2020](#); [Hershbein, Macaluso and Yeh, 2022](#); [Brooks et al., 2021b](#)), it
695 has some important shortcomings. First, this approach assumes that the production function
696 is constant for all firms within an industry and differs only by a factor-neutral productivity
697 parameter. Second, the identification of the production function relies on assumptions that

²¹In our data, material expenditures include the value of raw materials and intermediate input expenses during production, administrative, and operative processes.

698 preclude the estimation of the output elasticity of materials, which is necessary to apply the
699 [de Loecker and Warzynski \(2012\)](#) formula.²² In light of these shortcomings, we also test our
700 baseline results using two alternative estimates of markups. In the first alternative approach,
701 we estimate markups using the gross profit margin, which is computed as $\frac{\text{sales}}{\text{costs}}$. The gross
702 profit margin is a valid estimate of the markup if the production function is constant returns
703 to scale and the firm is price-taking in its inputs.²³ The second alternative approach assumes
704 that the production function is Cobb-Douglas. Under this strong assumption, the output
705 elasticity of materials is constant for all firms, and we choose $\theta^M = 0.8$ so that the average
706 markup from using this approach equals the average measured using the gross profit margin
707 method.

708 To compute labor markdowns, we first compute the ratio of the labor-based markup to
709 the materials-based markup. The equation can be expressed as

$$\frac{\mu_{it}^L}{\mu_{it}^M} = \frac{\theta_{it}^L}{\alpha_{it}^L} \cdot \frac{\alpha_{it}^M}{\theta_{it}^M},$$

710 where α_{it}^L and α_{it}^M represent the factor payment share for labor and materials, and θ_{it}^L and
711 θ_{it}^M represent the output elasticities. This equation comes naturally from solving the firm's
712 profit maximization problem and is derived formally as in [Hershbein, Macaluso and Yeh](#)
713 [\(2022\)](#). Normally, $\frac{\mu_{it}^L}{\mu_{it}^M}$ represents any unnamed distortion on labor relative to materials.
714 Following the literature, we assume that there is no exercise of market power in the market
715 for materials. Therefore, $\frac{\mu_{it}^L}{\mu_{it}^M}$ identifies only distortion to labor.

716 Second, we follow [Brooks et al. \(2021b\)](#) and interpret the comovement of $\frac{\mu_{it}^L}{\mu_{it}^M}$ with a firm's

²²See [Morlacco \(2019\)](#) for recent work that uses data on French firms to highlight significant monopsony market power for imported intermediate inputs relative to domestic intermediate inputs. Our paper assumes instead that Chinese importers are price-takers for materials. [Morlacco \(2019\)](#) also discusses challenges to the estimations of markups when this assumption does not hold. We address these potential biases in our robustness exercises.

²³The costs of production include labor payments, material expenditures, and payments to capital. Labor payments and material expenditures are directly from the data. To compute the payments to capital, like [Brooks et al. \(2021b\)](#), we assume a standard depreciation rate of $\delta = 0.05$ and an interest rate of $r = 0.10$ so that the return to capital for a Chinese manufacturing firm is $\delta + r = 0.15$.

717 labor market share as the exercise of monopsony power in the labor market. Specifically, we
718 estimate the following equation:

$$\frac{\mu_{it}^L}{\mu_{it}^M} = \Gamma_t + \delta_i + \beta s_{it}^L + \epsilon_{it}, \quad (\text{Appendix B.1})$$

719 where $s_{it}^L = \frac{w_{it}^L}{\sum_{l \in l} w_{it}^L}$ denotes firm i 's share in the labor market l at time i . We rescale the ratio
720 $\frac{\mu_{it}^L}{\mu_{it}^M}$ so that it has an average intercept of one in the equation (Appendix B.1). Rescaling
721 assures us that eliminating the market power in the labor market (i.e., the component of
722 this markdown that covaries with labor market share) is equivalent to setting the average
723 markdown to one.

724 The final step of computing markdowns requires us to define the appropriate labor market
725 for computing a firm's labor market share. We consider labor markets to be segmented both
726 geographically and by type of work. Concerning geography, we believe that provinces are an
727 appropriate choice for the labor market, since cross-province migration in China is restricted
728 by the Hukou system. Regarding the type of work, we assume that workers have a degree
729 of specialization and hence cannot move perfectly across 4-digit industries.

730 **Appendix C. Appendix: Model with Derivations and**
731 **Proofs**

732 **Environment**

733 We consider an economy in which firms can exercise labor market power in their local labor
734 market indexed by $k \in \mathcal{K}$. Each labor market k is populated by a continuum of workers who
735 elastically supply labor to the discrete set $\mathcal{I}_k = \{1, \dots, N_k\}$ of firms operating locally.

736 **Firm Problem**

737 Let a firm indexed by i have a production function $y_i = z_i F(\ell_i, m_i)$ where ℓ_i is the firm's
738 labor input and m_i is the firm's intermediate input. We assume the firm is price-taking in
739 the market for intermediate inputs m . Given tariffs τ_k and world prices \tilde{r} , we denote the
740 intermediate input prices $r_k \equiv (1 + \tau_k)\tilde{r}$.

741 However, the firm can exercise labor market power when hiring labor ℓ in its labor market
742 k , that $\frac{\partial w_{i,k}}{\partial \ell_i} \neq 0$ where $w_{i,k}$ denotes the wage in i 's labor market k . The firm is also assumed
743 to have market power in its output market, that is $\frac{\partial p_i}{\partial y_i} \neq 0$ where p_i denotes the price of firm
744 i 's output.

745 The problem of a firm i located in location k , given the inverse demand function $p(y_i; \cdot)$,
746 the choices of other firms $\{\ell_j\}_{j \neq i}$ and intermediate input prices $r_k \equiv (1 + \tau_k)\tilde{r}$ is

$$\begin{aligned} \max_{\ell_i, m_i} \quad & p(y_i; \cdot)y_i - w_{i,k}(\ell_i; \cdot)\ell_i - r_k m_i & (2) \\ \text{s.t.} \quad & y_i = z_i F(\ell_i, m_i) \end{aligned}$$

747

Optimality conditions and the price-taking assumption for r_k yield:

$$\frac{r_k}{z_i F_{m_i}(\cdot)} = \frac{\partial p(y_i)}{\partial y_i} \times y_i + p(y_i) \quad (\text{Appendix C.1})$$

$$\frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot)} = \frac{\partial p(y_i)}{\partial y_i} \times y_i + p(y_i) - \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} \times \ell_i \times \frac{1}{z_i F_{\ell_i}(\cdot)} \quad (\text{Appendix C.2})$$

748

where $F_\ell(\ell, m) \equiv \partial F(\ell, m)/\partial \ell$ and $F_m(\ell, m) \equiv \partial F(\ell, m)/\partial m$.

749

Note that in the absence of labor market power, we have $\frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} = 0$ and therefore the

750

ratio of factor payment shares equals the ratio of output elasticities:

$$\frac{r_k}{z_i F_{m_i}(\cdot)} = \frac{w_{i,k}}{z_i F_{\ell_i}(\cdot)} \Rightarrow \frac{r_k m_i}{w_{i,k} \ell_i} = \frac{F_{m_i}(\cdot) m_i}{F_{\ell_i}(\cdot) \ell_i}. \quad (\text{Appendix C.3})$$

751

Markups and Markdowns

752

We now define markups and markdowns before characterizing how markups vary with changes in input tariffs. The definitions below are useful as they map into measurements and estimation techniques we use in the empirical parts.

755

Definition 1 (Firm-level labor supply elasticities). *The inverse labor supply faced by a firm i is defined as*

756

$$\varepsilon_{i,k}^{-1}(\ell_i) \equiv \frac{\partial \log w_{i,k}(\ell_i)}{\partial \log \ell_i} = \frac{\ell_i}{w_{i,k}(\ell_i)} \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i}. \quad (\text{Appendix C.4})$$

757

Definition 2 (Firm-level labor supply elasticities). *The inverse labor supply faced by a firm i is defined as*

758

$$\varepsilon_{i,k}^{-1}(\ell_i) \equiv \frac{\partial \log w_{i,k}(\ell_i)}{\partial \log \ell_i} = \frac{\ell_i}{w_{i,k}(\ell_i)} \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i}. \quad (\text{Appendix C.5})$$

759

Definition 3 (Inverse product demand elasticities). *The inverse product demand elasticity*

760 faced by firm i is defined as:

$$-\sigma_i^{-1}(y_i) \equiv \frac{\partial \log p(y_i)}{\partial \log y_i} = \frac{y_i}{p(y_i)} \frac{\partial p(y_i)}{\partial y_i}. \quad (\text{Appendix C.6})$$

761 **Definition 4** (Output elasticities and factor payment shares). *The output elasticities from*
 762 *firm i 's production function with respect to materials and labor are defined as:*

$$\theta_{m_i}(\ell_i, m_i) \equiv \frac{\partial \log z_i F(\ell_i, m_i)}{\partial \log m_i} = \frac{m_i F_{m_i}(\cdot)}{F(\cdot)} \quad (\text{Appendix C.7})$$

763 and

$$\theta_{\ell_i}(\ell_i, m_i) \equiv \frac{\partial \log z_i F(\ell_i, m_i)}{\partial \log \ell_i} = \frac{\ell_i F_{\ell_i}(\cdot)}{F(\cdot)}. \quad (\text{Appendix C.8})$$

764 **Definition 5** (Output elasticities and factor payment shares). *The materials and labor*
 765 *payment shares for firm i are denoted by:*

$$\alpha_{m_i}(\ell_i, m_i) \equiv \frac{r_k m_i}{p(y_i) z_i F(\cdot)} \quad (\text{Appendix C.9})$$

766 and

$$\alpha_{\ell_i}(\ell_i, m_i) \equiv \frac{\ell_i w_{i,k}(\ell_i)}{p(y_i) z_i F(\cdot)}. \quad (\text{Appendix C.10})$$

767 Before deriving labor markdowns in the context of our model, we use these optimal-
 768 ity conditions to state two standard measurement results on labor market distortions and
 769 markup estimations. First, we state the common result that firm-level demand elasticities
 770 operate as a labor wedge in the allocation of labor.

771 More generally, we get from the optimality conditions that

$$\frac{r_k}{z_i F_{m_i}(\cdot)} = \frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot)} + \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} \times \ell_i \times \frac{1}{z_i F_{\ell_i}(\cdot)}. \quad (\text{Appendix C.11})$$

772 Rearranging the terms, we then get the relationship below which we will leverage later:

$$\frac{F_{\ell_i}(\cdot)}{F_{m_i}(\cdot)} = \frac{w_{i,k}(\ell_i)}{r_k} \left[1 + \frac{\ell_i}{w_{i,k}(\ell_i)} \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} \right] \quad (\text{Appendix C.12})$$

773 **Lemma 1** (Labor market power as labor wedge). *The firm optimality conditions imply the*
 774 *standard formulation that labor market power, in the sense of positive firm-level inverse labor*
 775 *supply elasticities ($\varepsilon_{i,k}^{-1}(\ell_i) > 0$), acts as a wedge distorting the allocation of labor relative to*
 776 *the competitive market allocation:*

$$\frac{F_{\ell_i}(\cdot)}{F_{m_i}(\cdot)} = \frac{\lambda}{\mu} = \frac{w_{i,k}(\ell_i)}{r_k} [1 + \varepsilon_{i,k}^{-1}(\ell_i)]. \quad (3)$$

777 Moreover, we get that

$$\frac{r_k}{z_i F_{m_i}(\cdot)} = \frac{\partial p(y_i)}{\partial y_i} \times y_i + p(y_i) \quad (\text{Appendix C.13})$$

$$\frac{r_k}{z_i F_{m_i}(\cdot)} = p(y_i) \left[\frac{\partial p(y_i)}{\partial y_i} \times \frac{y_i}{p(y_i)} + 1 \right] \quad (\text{Appendix C.14})$$

778 The second common result shows that materials-based markups depend on product de-
 779 mand elasticities and push materials marginal revenue above their marginal cost.

780 **Theorem 7** (Markup over intermediate input). *The inverse product demand elasticity faced*
 781 *by the firm implies a markup $[1 - \sigma_i^{-1}(y_i)]^{-1}$ over intermediate input prices r_k such that:*

$$p(y_i) = [1 - \sigma_i^{-1}(y_i)]^{-1} \frac{r_k}{z_i F_{m_i}(\cdot)}. \quad (6)$$

782

Similarly, for labor, the ratio of the marginal cost and the marginal product satisfies:

$$\begin{aligned}\frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot)} &= \frac{\partial p(y_i)}{\partial y_i} \times y_i + p(y_i) - \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} \times \ell_i \times \frac{1}{z_i F_{\ell_i}(\cdot)} \\ \frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot) p(y_i)} &= [1 - \sigma_i^{-1}(y_i)] - \frac{\partial w_{i,k}(\ell_i)}{\partial \ell_i} \times \ell_i \times \frac{1}{z_i F_{\ell_i}(\cdot) p(y_i)} \\ \frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot) p(y_i)} &= [1 - \sigma_i^{-1}(y_i)] - \varepsilon_{i,k}^{-1}(\ell_i) \times \frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot) p(y_i)}\end{aligned}$$

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787

As a result, we can derive that the labor-based markup is a function of both product market frictions and labor market monopsony power. Following the literature, we define labor markdowns as the labor-based markup divided by the materials-based markup, an input for which we assume the firm is a price-taker. The theorem below states these standard results formally.

788

789

Lemma 2 (Labor markdowns). *The labor markdown—the ratio of the labor-based markup and the materials-based markup—for firm i equals*

$$[1 + \varepsilon_{i,k}^{-1}(\ell_i)]. \quad (4)$$

790

791

792

The results above form the basis of the estimation techniques used in the paper and in the literature. The corollary below states how factor shares and output elasticities are used to measure markups and markdowns, as we do in the empirical section.

793

794

Corollary 8 (Factor payment shares, output elasticities, and markup estimation). *Markups can be derived from factor payment shares and output elasticities since*

$$\theta_{m_i} = [1 - \sigma_i^{-1}(y_i)]^{-1} \alpha_{m_i} \quad (\text{Appendix C.15})$$

795

and

$$\theta_{\ell_i} = [1 + \varepsilon_{i,k}^{-1}(\ell_i)] [1 - \sigma_i^{-1}(y_i)]^{-1} \alpha_{\ell_i}. \quad (\text{Appendix C.16})$$

796 For verification, note that this yields, as expected:

$$\begin{aligned}
[1 + \varepsilon_k^{-1}(\ell_i)] \frac{w_{i,k}(\ell_i)}{z_i F_{\ell_i}(\cdot) p(y_i)} &= [\sigma_i^{-1}(y_i) + 1] \\
\frac{r_k}{z_i F_{m_i}(\cdot) p(y_i)} &= [\sigma_i^{-1}(y_i) + 1] \\
[1 + \varepsilon_k^{-1}(\ell_i)] \frac{w_{i,k}(\ell_i)}{r_k} &= \frac{F_{\ell_i}(\cdot)}{F_{m_i}(\cdot)}
\end{aligned}$$

797 Having re-derived these identities in the context of our environment, we now make simpli-
798 fying assumptions and turn to the endogenous response of the labor markdown to exogenous
799 changes in the tariffs over intermediate inputs.

800 Deriving Optimal Allocations

801 The generality of the previous section allowed us to incorporate the measurement and esti-
802 mation of markups and markdowns used in our empirical exercises. We now make a couple of
803 simplifying parametric assumptions in order to derive an analytical characterization of mark-
804 downs. First, we assume that the firm has a Cobb-Douglas production function. Second, we
805 restrict the demand to the standard constant elasticity of the substitution system.

806 **Assumption 1** (Cobb-Douglas production function). *The production function satisfies*
807 $y_i = z_i F(\ell, m) = z_i \ell^\lambda m^\mu$ *with* $\lambda > 0$, $\mu > 0$. *The implied output elasticities with respect*
808 *to labor and materials satisfy* $\theta_\ell(\ell, m) = \lambda$ *and* $\theta_m(\ell, m) = \mu$.

809 **Assumption 2** (Constant inverse demand elasticity). *The inverse demand function satisfies*
810 $p(y_i) = A y_i^{-\sigma^{-1}}$ *with* $\sigma > 1$ *and* $A > 0$. *The inverse product demand elasticity faced by the*
811 *firm is therefore given by* $-\sigma_i^{-1}(y_i) = -\sigma^{-1}$.

812

Recall that the objective of the firm is

$$\begin{aligned} \max_{\ell_i, m_i} \quad & p(y_i; \cdot) y_i - w_{i,k}(\ell_i; \cdot) \ell_i - r_k m_i \\ \text{s.t.} \quad & y_i = z_i F(\ell_i, m_i) \end{aligned}$$

813

Substituting for $\alpha_{m_i} = [1 - \sigma_i^{-1}(y_i)] \theta_{m_i}$, we obtain:

$$\begin{aligned} \max_{\ell_i, y_i} \quad & p(y_i; \cdot) y_i - w_{i,k}(\ell_i; \cdot) \ell_i - [1 - \sigma_i^{-1}(y_i)] \theta_{m_i} p(y_i; \cdot) y_i \\ \text{or} \\ \max_{\ell_i, y_i} \quad & \left(1 - [1 - \sigma_i^{-1}(y_i)] \theta_{m_i}\right) p(y_i; \cdot) y_i - w_{i,k}(\ell_i; \cdot) \ell_i. \end{aligned}$$

814

Denote $\tilde{\mu} \triangleq [1 - \sigma^{-1}] \mu$, $\tilde{\lambda} \triangleq [1 - \sigma^{-1}] \lambda$, and $\tilde{z}_i \triangleq z_i^{1-\sigma^{-1}}$.

815

Let us denote output elasticities and productivity parameters adjusted for the demand

816

elasticity as $\tilde{\mu} \triangleq [1 - \sigma^{-1}] \mu$, $\tilde{\lambda} \triangleq [1 - \sigma^{-1}] \lambda$, and $\tilde{z}_i \triangleq z_i^{1-\sigma^{-1}}$.

817

We can rewrite the optimal intermediate input share formula to yield

$$\begin{aligned} \frac{r_k m_i}{p(y_i) y_i} &= [1 - \sigma^{-1}] \mu \\ r_k m_i &= \tilde{\mu} \times A \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} m_i^{\tilde{\mu}} \right]. \end{aligned}$$

818

We get as a result that the materials demanded satisfies:

$$m_i^{1-\tilde{\mu}} = \frac{1}{r_k} \tilde{\mu} \times A \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]. \quad (\text{Appendix C.17})$$

An additional substitution in the formula for revenues yields:

$$\begin{aligned}
p(y_i)y_i &= A\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \left[m_i^{1-\tilde{\mu}} \right]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} \\
p(y_i)y_i &= A\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \left[\frac{1}{r_k} \tilde{\mu} \times A \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right] \right]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} \\
p(y_i)y_i &= \left[\frac{1}{r_k} \tilde{\mu} \right]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} \left\{ A \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right] \right\}^{\frac{1}{1-\tilde{\mu}}}.
\end{aligned}$$

The firm's problem can then be written as a labor demand problem such that:

$$\begin{aligned}
&\max_{\ell_i} (1 - \tilde{\mu}) p(y_i; \cdot) y_i - w_{i,k}(\ell_i; \cdot) \ell_i \\
&\max_{\ell_i} (1 - \tilde{\mu}) \left[\frac{1}{r_k} \tilde{\mu} \right]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} \left\{ A \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right] \right\}^{\frac{1}{1-\tilde{\mu}}} - w_{i,k}(\ell_i; \cdot) \ell_i \\
&\max_{\ell_i} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} - w_{i,k}(\ell_i; \cdot) \ell_i \tag{7}
\end{aligned}$$

821 where $B(r_k) \triangleq (1 - \tilde{\mu}) \left[\tilde{\mu}/r_k \right]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} [A]^{\frac{1}{1-\tilde{\mu}}}$.

The first-order conditions with respect to ℓ_i yield:

$$\frac{\tilde{\lambda}}{1 - \tilde{\mu}} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} \times \frac{1}{\ell_i} = w_{i,k}(\ell_i; \cdot) + \frac{\partial w_{i,k}(\ell_i; \cdot)}{\partial \ell_i} \ell_i \tag{Appendix C.18}$$

$$\frac{\tilde{\lambda}}{1 - \tilde{\mu}} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} \times \frac{1}{w_{i,k}(\ell_i; \cdot) \ell_i} = 1 + \frac{\partial w_{i,k}(\ell_i; \cdot)}{\partial \ell_i} \frac{\ell_i}{w_{i,k}(\ell_i; \cdot)} \tag{Appendix C.19}$$

The first-order conditions with respect to ℓ_i imply that the equilibrium labor allocations

$\{\ell_i\}_i$ jointly satisfy a system of equations such that

$$\frac{\tilde{\lambda}}{1 - \tilde{\mu}} B(r_k) \times \left[\tilde{z}_i \times \ell_i^{\tilde{\lambda}} \right]^{\frac{1}{1-\tilde{\mu}}} \times \frac{1}{w_{i,k}(\ell_i; \cdot) \ell_i} = 1 + \varepsilon_k^{-1}(\ell_i) \quad \forall i. \tag{8}$$

In order to gain more analytical tractability, we turn to an assumption on the wage

function faced by the firm. In particular, we assume a log-linear wage function with respect

827 to the firm's demand.

Assumption 3 (Wage function). *Given other firms' labor demands $\{\ell_j : j \neq i\}$, the wage function for a given firm i demanding ℓ_i units of labor in labor market k satisfies*

$$w_{i,k}(\ell_i, \cdot) = \left[\frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi} \right]^{\frac{\eta}{\varphi}} (\mathcal{L}_{-i}^\varphi + \ell_i^\varphi)^{\frac{\nu}{\varphi}},$$

828 where $\mathcal{L}_{-i}^\varphi \triangleq \sum_{j \neq i, j \in \mathcal{I}_k} \ell_j^\varphi$.

829 Returning to the FOCs, we get

$$\begin{aligned} \frac{\partial \log w_k(\ell_i)}{\partial \log \ell_i} &= \frac{\partial \left[\eta \log(\ell_i) + \frac{\nu - \eta}{\varphi} \log(\mathcal{L}_{-i}^\varphi + \exp(\varphi \log \ell_i)) \right]}{\partial \log \ell_i} \\ \varepsilon_k^{-1}(\ell_i) &= \eta + \frac{\nu - \eta}{\varphi} \frac{\varphi \exp(\varphi \log \ell_i)}{\mathcal{L}_{-i}^\varphi + \exp(\varphi \log \ell_i)} \\ \varepsilon_k^{-1}(\ell_i) &= \eta + (\nu - \eta) \frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi}. \end{aligned}$$

830 Therefore, under this modified log linear wage assumption, the labor supply elasticity
831 faced by firm i is

$$\varepsilon_k^{-1}(\ell_i) \equiv \frac{\partial \log w_k(\ell_i)}{\partial \log \ell_i} = \eta + (\nu - \eta) \frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi}.$$

832 It is important to note that in the common case of an iso-elastic, that is $(\nu - \eta) = 0$,
833 we have a constant firm-level inverse labor supply elasticity $\varepsilon_k^{-1}(\ell_i)$. In that case, the labor
834 markdown $(1 + \varepsilon_k^{-1}(\ell_i))$ would also be constant and would not vary with tariff changes.

835 Note also that under the BHM formulation s.t.

$$\begin{aligned} \log w &\propto \frac{1}{\eta_{BHM}} n_i + \left(\varphi_{BHM} - \frac{1}{\eta_{BHM}} \right) \log N_{-i} \\ \log w &\propto \frac{1}{\eta_{BHM}} n_i + \left(\varphi_{BHM} - \frac{1}{\eta_{BHM}} \right) \left(\frac{1 + \eta_{BHM}}{\eta_{BHM}} \right)^{-1} \log \left(N_{-i}^{\frac{1 + \eta_{BHM}}{\eta_{BHM}}} + n_i^{\frac{1 + \eta_{BHM}}{\eta_{BHM}}} \right), \end{aligned}$$

836 we have the following mapping: $\eta = \frac{1}{\eta_{BHM}}$, $\varphi = \frac{1 + \eta_{BHM}}{\eta_{BHM}}$, $\nu = \varphi_{BHM}$.

837 More generally, under the log-linear wage assumption above, we derive the firm's optimal
 838 labor demand decision in the following theorem.

839 **Theorem 3** (Optimal labor demand). *The optimal labor demanded by firm i , given other*
 840 *firms' strategies \mathcal{L}_{-i} and given intermediate input prices $r_k \equiv (1 + \tau_k)\tilde{r}$, solves*

$$\left(1 + \eta + (\nu - \eta) \frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi}\right) \left(\frac{\ell_i^\varphi}{\mathcal{L}_{-i}^\varphi + \ell_i^\varphi}\right)^{\frac{-(\nu-\eta)}{\varphi}} \ell_i^{(1+\nu)-\frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1-\tilde{\mu}} B(r_k) [\tilde{z}_i]^{\frac{1}{1-\tilde{\mu}}}. \quad (9)$$

841 The optimal labor demand equation implicitly defines the firm's labor demand as a
 842 function of the other firms' strategies \mathcal{L}_{-i} and the material price $r_k \equiv (1 + \tau_k)\tilde{r}$. The
 843 dependence on other firms' decisions highlights that markdowns are jointly determined as a
 844 labor market equilibrium outcome. The next assumption allows us to capture labor market
 845 clearing conditions and to study the implied equilibrium markdown outcomes.

846 Combining the aggregate labor supply condition above with the firm inverse labor supply
 847 elasticity, we derive an intuitive and useful result on markdowns in the case of a symmetric
 848 equilibrium. Indeed, when all local firms are homogeneous, $\ell_i = \ell \Rightarrow \ell = L_k/N_k$ and the
 849 implied equilibrium number of firms N_k also governs equilibrium markdowns.

850 **Corollary 9** (Entry and labor market power in symmetric equilibria). *In a symmetric*
 851 *equilibrium (that is, $z_i = z_k, \ell_i = \ell_k \forall i \in N_k$), the extensive margin N_k of active firms*
 852 *governs the equilibrium labor markdown which simplifies to:*

$$[1 + \varepsilon_k^{-1}(\ell_k)] = 1 + \eta + \frac{(\nu - \eta)}{N_k}.$$

853 Moreover, in this symmetric equilibrium, after substituting for the aggregate labor market
 854 condition ($N_k \times \ell = L_k$), the optimal firm labor demand implies an equilibrium firm entry
 855 equation.

$$\left(1 + \eta + (\nu - \eta) \frac{1}{N_k}\right) \left(\frac{1}{N_k}\right)^{\frac{-(\nu-\eta)}{\varphi}} \ell^{(1+\nu)-\frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1-\tilde{\mu}} [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k). \quad (\text{Appendix C.20})$$

856 This equilibrium condition implies

$$\ell^{(1+\nu)-\frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1-\tilde{\mu}} [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k) (N_k)^{-\frac{(\nu-\eta)}{\varphi}} \left(1 + \eta + \frac{1}{N_k}(\nu - \eta)\right)^{-1}. \quad (\text{Appendix C.21})$$

857 Using the aggregate labor market condition: $N_k \times \ell = L_k$, we get:

$$\left[\frac{L_k}{N_k}\right]^{(1+\nu)-\frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1-\tilde{\mu}} [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k) (N_k)^{-\frac{(\nu-\eta)}{\varphi}} \left(1 + \eta + \frac{1}{N_k}(\nu - \eta)\right)^{-1}. \quad (\text{Appendix C.22})$$

858 We also showed previously that, in this case, the markdown is a simple function of
 859 the number of operating firms. Therefore, this firm entry equation closes the local labor
 860 market equilibrium. Technically, the equilibrium number of firms N_k needs to be an integer.
 861 We consider the equilibrium condition on the real line for the purpose of our variational
 862 analysis.

863 **Corollary 4** (Symmetric Local Equilibrium and Entry). *In a symmetric equilibrium (that*
 864 *is, $z_i = z_k$ and $\ell_i = \ell_k \forall i \in N_k$), given materials prices r_k and aggregate labor L_k , the*
 865 *number of firms N_k satisfies*

$$\left(N_k\right)^{\frac{(\nu-\eta)}{\varphi}} \left(1 + \eta + (\nu - \eta) \frac{1}{N_k}\right) \left(\frac{L_k}{N_k}\right)^{(1+\nu)-\frac{\tilde{\lambda}}{1-\tilde{\mu}}} = \frac{\tilde{\lambda}}{1-\tilde{\mu}} [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k)$$

866 with $\ell_k = \frac{L_k}{N_k}$. Furthermore, the labor markdown is $[1 + \varepsilon_k^{-1}(\ell_k)] = 1 + \eta + \frac{(\nu-\eta)}{N_k}$.

867 Taking logs, we get:

$$\left((1 + \nu) - \frac{\tilde{\lambda}}{1-\tilde{\mu}} - \frac{(\nu-\eta)}{\varphi}\right) \log N_k - \log \left(1 + \eta + \frac{(\nu-\eta)}{N_k}\right) \quad (\text{Appendix C.23})$$

$$= \left((1 + \nu) - \frac{\tilde{\lambda}}{1-\tilde{\mu}}\right) \log L_k \quad (\text{Appendix C.24})$$

$$- \log \left(\frac{\tilde{\lambda}}{1-\tilde{\mu}}\right) - \left(\frac{1}{1-\tilde{\mu}}\right) \log \tilde{z} \quad (\text{Appendix C.25})$$

$$- \log B(r_k) \quad (\text{Appendix C.26})$$

868 where $B(r_k) \triangleq (1 - \tilde{\mu}) [\tilde{\mu}/r_k]^{1-\tilde{\mu}} [A]^{1-\tilde{\mu}}$.

869 Note that

$$\left((1 + \nu) - \frac{\tilde{\lambda}}{1 - \tilde{\mu}} - \frac{(\nu - \eta)}{\varphi} \right) = \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \frac{\varphi - 1}{\varphi} \nu + \frac{\eta}{\varphi} \right) > 0$$

870 and

$$\left((1 + \nu) - \frac{\tilde{\lambda}}{1 - \tilde{\mu}} \right) = \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu \right) > 0.$$

871 We are now ready to study how entry, and thereby markdowns, change with input tariff
 872 reductions. By taking the aggregate labor supply L_k as given, we effectively abstracted
 873 from the household labor market choice problem. We introduce an additional assumption
 874 capturing how this aggregate supply changes with local input tariff changes, say due to
 875 changes in wages.

876 **Assumption 4** (Aggregate labor supply elasticity). *Input tariff changes affect equilibrium*
 877 *labor supply through wages such that*

$$\frac{\partial \log L_k}{\partial \log((1 + \tau_k)\tilde{r})} = \frac{\partial \log L_k}{\partial \log w_k} \times \frac{\partial \log w_k}{\partial \log((1 + \tau_k)\tilde{r})} \triangleq -\kappa \leq 0.$$

878 **Discussion** This assumption is a reduced-form way of capturing the elasticity of labor
 879 supply across locations and labor markets, when local wages and local labor demand change
 880 in response to reduced intermediate input tariffs. In a full model with labor market choice,
 881 this elasticity would be fully endogenous to labor market conditions across locations. Since
 882 we do not model the location choice margin, we think our assumption is a simple and
 883 clear way to state the key condition needed to understand our results. In our model with
 884 symmetric firms, if the labor supply does not expand, fewer firms would operate in response
 885 to increased labor demand arising from lower input prices. As shown earlier, labor market

886 power is decreasing in the number of operating firms. This assumption therefore allows for
 887 labor force expansions that offset this mechanism. We formalize this finding in the theorem
 888 below.

889 First, note that

$$\begin{aligned}
 \frac{\partial \log \left(1 + \eta + \frac{(\nu - \eta)}{N_k}\right)}{\partial \log N_k} &= \frac{N_k}{\left(1 + \eta + \frac{(\nu - \eta)}{N_k}\right)} \frac{\partial \left(1 + \eta + \frac{(\nu - \eta)}{N_k}\right)}{\partial N_k} \\
 &= -\frac{N_k}{\left(1 + \eta + \frac{(\nu - \eta)}{N_k}\right)} \frac{(\nu - \eta)}{(N_k)^2} \\
 &= -\frac{(\nu - \eta)}{(1 + \eta)N_k + (\nu - \eta)}.
 \end{aligned}$$

890 Taking derivatives $\frac{\partial}{\partial \log r_k}$ on the equilibrium conditions, we then get

$$\frac{\partial \log N_k}{\partial \log r_k} = \frac{\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}}\right) - \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu\right) \kappa}{\left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \frac{\varphi - 1}{\varphi} \nu + \frac{\eta}{\varphi}\right) + \left[\left(\frac{1 + \eta}{\nu - \eta}\right) N_k + 1\right]^{-1}}$$

891 by applying the chain rule and substituting for the aggregate labor supply elasticity term.

892 **Theorem 5** (Intermediate input prices and labor market power). *Labor markdowns* $(1 + \varepsilon_k^{-1})$
 893 *decline (and the equilibrium number N_k of firms increases) with lower intermediate input*
 894 *prices iff*

$$\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}}\right) - \left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu\right) \kappa < 0 \iff \kappa > \frac{\left(\frac{\tilde{\mu}}{1 - \tilde{\mu}}\right)}{\left(\frac{1 - \tilde{\mu} - \tilde{\lambda}}{1 - \tilde{\mu}} + \nu\right)}. \quad (11)$$

895 This theorem summarizes a key insight from our simple model. While the firm-level labor
 896 supply elasticity shapes its exercise of labor market power, its equilibrium labor markdown
 897 response to a change in input tariffs also critically depends on the aggregate labor supply
 898 elasticity. We will test these key implications in our data using a couple of relevant variations
 899 across labor markets.

900 Before turning to the evidence supporting this mechanism, we also characterize the role
 901 of skill intensity in the effect of input trade liberalization on markdowns.

902 The assumption we make here in mapping labor intensity in the model to skill intensity
 903 is that even though both skilled and unskilled labor are subject to frictions, skilled labor
 904 markets are more subject to monopsony power frictions. We argue that due to both govern-
 905 ment regulation and extensive supply, firms are more likely to be price-takers for unskilled
 906 labor.

907 In the context of our model, we explore the role of skill intensity by applying $\frac{\partial}{\partial \tilde{\lambda}}$ to $\frac{\partial \log N_k}{\partial \log r_k}$:

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{\partial}{\partial \tilde{\lambda}} \frac{\left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu \right) \kappa}{\left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1}} \\ &= \frac{- \left(\frac{-1}{1-\tilde{\mu}} \right) \kappa \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad - \frac{\left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu \right) \kappa \right\} \left(\frac{-1}{1-\tilde{\mu}} + X \right)}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \end{aligned}$$

908 where $X \triangleq \frac{\partial \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1}}{\partial \tilde{\lambda}} = - \left(\frac{1+\eta}{\nu-\eta} \right) \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-2} \frac{\partial N_k}{\partial \tilde{\lambda}}$.

909 Combining this, we get

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{- \left(\frac{-1}{1-\tilde{\mu}} \right) \kappa \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad - \frac{\left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu \right) \kappa \right\} \left(\frac{-1}{1-\tilde{\mu}} + - \left(\frac{1+\eta}{\nu-\eta} \right) \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-2} \frac{\partial N_k}{\partial \tilde{\lambda}} \right)}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \end{aligned}$$

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{\left(\frac{1}{1-\tilde{\mu}}\right) \left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}}\right) - \kappa \left(\frac{\nu-\eta}{\varphi}\right) + \kappa \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-1} \right\}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi}\right) + \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-1} \right\}^2} \\ &+ \frac{\left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}}\right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu\right) \kappa \right\} \left(\left(\frac{1+\eta}{\nu-\eta}\right) \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-2} \frac{\partial N_k}{\partial \tilde{\lambda}} \right)}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi}\right) + \left[\left(\frac{1+\eta}{\nu-\eta}\right) N_k + 1\right]^{-1} \right\}^2} \end{aligned}$$

910 Let us now take the derivatives of the equilibrium conditions to get $\frac{\partial N_k}{\partial \tilde{\lambda}}$:

$$\begin{aligned} -\frac{1}{1-\tilde{\mu}} \log N_k + \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) \frac{\partial \log N_k}{\partial \tilde{\lambda}} \\ + \frac{(\nu-\eta)}{(1+\eta)N_k + (\nu-\eta)} \frac{\partial \log N_k}{\partial \tilde{\lambda}} \\ = -\frac{1}{1-\tilde{\mu}} \log L_k - \frac{1}{\tilde{\lambda}} \end{aligned}$$

911 Therefore, we group terms to get

$$\begin{aligned} \frac{\partial \log N_k}{\partial \tilde{\lambda}} &= \left(\frac{1}{1-\tilde{\mu}} \log N_k - \frac{1}{1-\tilde{\mu}} \log L_k - \frac{1}{\tilde{\lambda}} \right) \\ &/ \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \frac{(\nu-\eta)}{(1+\eta)N_k + (\nu-\eta)} \right\} \end{aligned}$$

912

$$\begin{aligned} \frac{\partial \log N_k}{\partial \tilde{\lambda}} &= -\frac{1}{1-\tilde{\mu}} \left(\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} \right) \\ &/ \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \frac{(\nu-\eta)}{(1+\eta)N_k + (\nu-\eta)} \right\} \end{aligned}$$

913

$$\begin{aligned} \frac{\partial \log N_k}{\partial \tilde{\lambda}} &= -\frac{1}{1-\tilde{\mu}} \left(\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} \right) \\ &/ \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[1 + \left(\frac{1+\eta}{\nu-\eta} \right) N_k \right]^{-1} \right\} \end{aligned}$$

Noting that $\frac{\partial N_k}{\partial \tilde{\lambda}} = N_k \frac{\partial \log N_k}{\partial \tilde{\lambda}}$, we conclude that

$$\frac{\partial N_k}{\partial \tilde{\lambda}} = -\frac{1}{1-\tilde{\mu}} N_k \left(\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} \right) / \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}.$$

We can now return to the original derivations and substitute to rewrite $\frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}}$ as

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{\left(\frac{1}{1-\tilde{\mu}} \right) \left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \kappa \left(\frac{\nu-\eta}{\varphi} \right) + \kappa \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad - \frac{\left(\frac{1+\eta}{\nu-\eta} \right) \left[\left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu \right) \kappa \right] \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-2}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad \times \left(\frac{1}{1-\tilde{\mu}} \right) N_k \left(\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} \right) \\ &\quad / \left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\} \end{aligned}$$

$$\begin{aligned} \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} &= \frac{\left(\frac{1}{1-\tilde{\mu}} \right) \left\{ \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \kappa \left(\frac{\nu-\eta}{\varphi} \right) + \kappa \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad + \frac{\left(\frac{1+\eta}{\nu-\eta} \right) \left[\left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu \right) \kappa - \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) \right] \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-2}}{\left\{ \left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \right\}^2} \\ &\quad \times \frac{\left(\frac{1}{1-\tilde{\mu}} \right) N_k \left(\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} \right)}{\left(\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \frac{\varphi-1}{\varphi} \nu + \frac{\eta}{\varphi} \right) + \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1}} \end{aligned}$$

916 Since $N_k \geq 1$ and $\nu > \eta > 0$,

$$\kappa \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} \in \left(0, \kappa \frac{\nu-\eta}{1+\nu} \right]$$

917 which implies

$$\left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \kappa \left(\frac{\nu-\eta}{\varphi} \right) + \kappa \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1} > \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) - \kappa \left(\frac{\nu-\eta}{\varphi} \right)$$

918 We can see that if

$$\begin{aligned} \left(\frac{\tilde{\mu}}{1-\tilde{\mu}} \right) &> \kappa \left(\frac{\nu-\eta}{\varphi} \right) \\ \text{and} \\ \log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} &> 0 \end{aligned}$$

919 then

$$\frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} > 0.$$

920 Note that the second condition $\log \frac{L_k}{N_k} + \frac{1-\tilde{\mu}}{\tilde{\lambda}} > 0$, is equivalent to $\frac{\partial N_k}{\partial \tilde{\lambda}} < 0$. We will
921 assume it is satisfied below because it holds trivially if z or A is large enough since

$$\left[\frac{L_k}{N_k} \right]^{\nu + \frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}}} = \left(\frac{\tilde{\lambda}}{1-\tilde{\mu}} \right) \left(\frac{1}{\nu-\eta} \right) [\tilde{z}]^{\frac{1}{1-\tilde{\mu}}} B(r_k) (N_k)^{-\frac{\nu-\eta-\varphi}{\varphi}} \left[\left(\frac{1+\eta}{\nu-\eta} \right) N_k + 1 \right]^{-1}$$

922 and $B(r_k) \triangleq (1-\tilde{\mu}) [\tilde{\mu}/r_k]^{\frac{\tilde{\mu}}{1-\tilde{\mu}}} [A]^{\frac{1}{1-\tilde{\mu}}}$.

923 The equation above allows us to characterize whether the cross-derivative is positive:
924 that is, as we found in the data, whether an input tariff reduction leads to a greater labor
925 markdown reduction when the skill intensity is higher. We show in the theorem below the

926 restriction needed for this amplification result to be true.

927 **Theorem 6** (Labor intensity, input tariffs, and equilibrium number of firms). *Skill intensity*
 928 *amplifies the increase in the number of firms and, equivalently, the associated reduction in*
 929 *markdowns arising from a decline in input prices; that is,*

$$\frac{\partial \log N_k}{\partial \log r_k} < 0 \quad \text{and} \quad \frac{\partial^2 \log N_k}{\partial \log r_k \partial \tilde{\lambda}} > 0,$$

930 *when*

$$\kappa \in \left(\frac{\frac{\tilde{\mu}}{1-\tilde{\mu}}}{\frac{1-\tilde{\mu}-\tilde{\lambda}}{1-\tilde{\mu}} + \nu}, \frac{\frac{\tilde{\mu}}{1-\tilde{\mu}}}{\frac{\nu-\eta}{\varphi}} \right). \quad (12)$$

931 Note that the two conditions in the theorem above require as a necessary condition

$$1 + \left(1 - \frac{1}{\varphi}\right) \nu + \frac{\eta}{\varphi} > \frac{\tilde{\lambda}}{1-\tilde{\mu}}. \quad (\text{Appendix C.27})$$

932 This necessary condition guarantees the existence of κ and is always true since

$$1 + \left(1 - \frac{1}{\varphi}\right) \nu + \frac{\eta}{\varphi} > 1 > \frac{\tilde{\lambda}}{1-\tilde{\mu}}. \quad (\text{Appendix C.28})$$

933 **Appendix D. Appendix: Model with Location Choice**

934 Here, we propose a micro-foundation for the labor supply function assumptions in the main
935 text. We build on the location choice problem in [Berger, Herkenhoff and Mongey \(2022\)](#),
936 henceforth BHM. Before presenting the environment, it is important to discuss the tension
937 we face in modelling worker location choice. Allowing for discrete location introduces a
938 double-nest of strategic interactions across firms, not only within a location but also across
939 locations. BHM use instead a continuum of locations, which effectively means that firms
940 in each island take economy-wide prices as given. Citing findings in [Malmberg and Hössjer](#)
941 [\(2018\)](#) and [Malmberg \(2013\)](#), BHM argue that the CES specification across a continuum
942 of locations is a limit of the discrete choice problem as the number of locations becomes
943 infinitely large.

944 **Environment**

945 Consider an economy in which local labor markets are indexed by k and belong to a con-
946 tinuum $\mathcal{K} = [0, 1]$. Each labor market k is populated by workers who belong to a repre-
947 sentative household. The representative household elastically supplies labor to the discrete
948 set $\mathcal{I}_k = \{1, \dots, N_k\}$ of firms operating locally on each atomistic island $k \in \mathcal{K}$. Firms can
949 exercise labor market power in their local labor market.

950 **Household Problem**

951 Assume the household chooses labor allocations and consumption to solve:

$$\mathcal{U} = \max_{\ell_{i,k}} U(\mathbb{C}) - V(\mathbb{L})$$

s.t.

$$\mathbb{C} = \mathbb{W}\mathbb{L} + \Pi$$

$$\mathbb{L}^{\frac{\theta+1}{\theta}} \equiv \int_{\mathcal{K}} \mathcal{L}_k^{\frac{\theta+1}{\theta}} dk$$

$$\mathcal{L}_k^{\frac{\eta_k+1}{\eta_k}} \equiv \sum_{i \in \mathcal{I}_k} \ell_{i,k}^{\frac{\eta_k+1}{\eta_k}}$$

$$\mathbb{W}\mathbb{L} = \int_{\mathcal{K}} \mathcal{W}_k \mathcal{L}_k dk$$

$$\mathcal{W}_k \mathcal{L}_k = \sum_{i \in \mathcal{I}_k} w_{i,k} \ell_{i,k}$$

952 **Household Optimization** The household first order conditions yield

$$\frac{U'(\mathbb{C})}{V'(\mathbb{L})} \frac{\partial \mathbb{L}}{\partial \mathcal{L}_k} \frac{\partial \mathcal{L}_k}{\ell_{i,k}} = w_{i,k}$$

953 This yields

$$\frac{w_{i,k}}{\mathbb{W}} = \left(\frac{\ell_{i,k}}{\mathcal{L}_k} \right)^{\frac{1}{\eta_k}} \left(\frac{\mathcal{L}_k}{\mathbb{L}} \right)^{\frac{1}{\theta}}$$

954 Suppose that

$$U(\mathbb{C}) = \mathbb{C} \text{ and } V(\mathbb{L}) = (\mathbb{L})^{\frac{1+\nu}{\nu}}$$

955 Under these assumptions, we derive the extended version of the wage function we had
 956 assumed in the main text:

957 **Assumption 5** (Wage function). *Given the labor demanded by other firms, $\{\ell_j : j \neq i\}$, the*

958 *wage function for a given firm i demanding l_i units of labor in labor market k satisfies*

$$w_k(l_i, \cdot) = \left(\frac{l_{i,k}}{\mathcal{L}_k} \right)^{\frac{1}{\eta_k}} \left(\frac{\mathcal{L}_k}{\mathbb{L}} \right)^{\frac{1}{\theta}} (\mathbb{L})^{-\frac{1}{\nu}}. \quad (\text{Appendix D.1})$$

959 The labor supply elasticity faced by firm i yields

$$\varepsilon_{i,k}(l_{i,k}) \equiv \frac{\partial \log w_{i,k}(l_{i,k})}{\partial \log l_{i,k}} = \frac{1}{\eta_k} + \left(\frac{1}{\theta} - \frac{1}{\eta_k} \right) \left(\frac{l_{i,k}}{\mathcal{L}_k} \right)^{\frac{1+\eta_k}{\eta_k}}. \quad (\text{Appendix D.2})$$

960 Equations [Appendix D.1](#) and [Appendix D.2](#) show that the labor supply location choice
 961 model presented here is a special case of Assumption 3 in the main text. They also highlight
 962 that η_k is also a potential source of heterogeneity across labor markets.

963 **Appendix E. Appendix: Counterfactual Aggregate Out-**
 964 **comes**

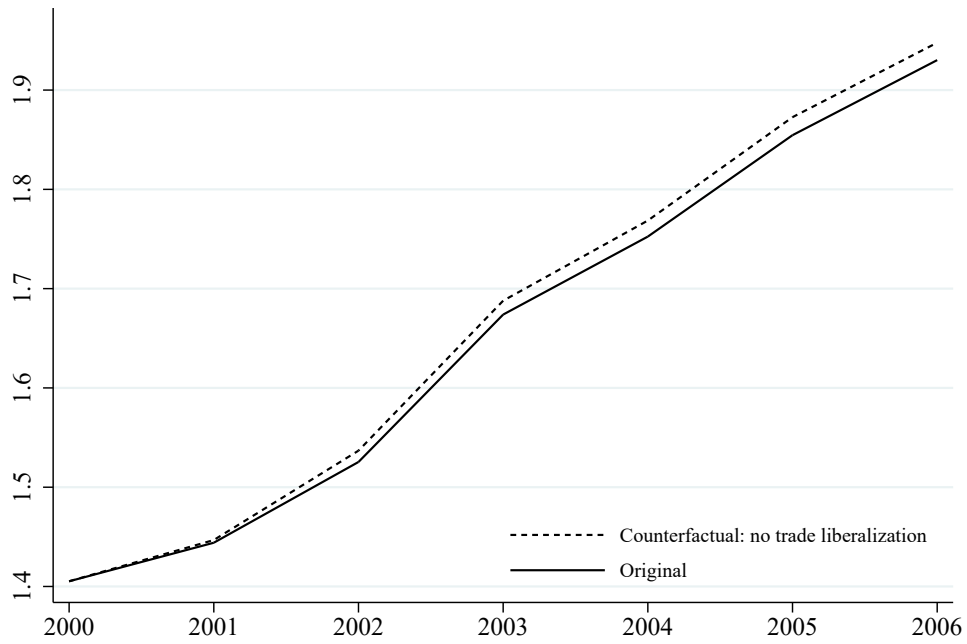
965 [Brooks et al. \(2021b\)](#) show that the reciprocal of the labor share depends on product markups
 966 and labor markdowns in the following way:

$$\frac{1}{\eta_L} = \sum_{i=1}^I \sum_{k=1}^K \sum_{n=1}^{N_{ki}} \left[\frac{\mu_{nki}^L \mu_{nki}^M - \theta_{nki}^M \omega_{nki}^L}{\mu_{nki}^M \theta_{nki}^L} \right]. \quad (\text{Appendix E.1})$$

967 where $\frac{\mu_{nki}^L}{\mu_{nki}^M}$ is labor markdown of firm i in industry n in location k and θ_{nki} refers to the
 968 output elasticity of firm i with respect to material or labor. ω_{nki}^L is the labor share of firm i
 969 in the national labor pool. Using this equation, we calculate the counterfactual labor share
 970 in the absence of trade liberalization.

971 To compute counterfactual labor share, we first compute counterfactual labor markdown
 972 in the absence of trade liberalization. Using the coefficient in the Column (2) of Table
 973 [2](#), we compute the counterfactual markdown of a given firm holding industry tariffs at
 974 the level equal to that of year 2000. The counterfactual markdown represents the level of
 975 markdown if input tariffs do not decrease as a result of trade liberalization. Figure [E.1](#) shows
 976 the counterfactual markdowns aggregate to the national level weighted by firms' output
 977 share. We then replace the actual labor markdown with the counterfactual markdown in the
 978 equation [Appendix E.1](#) to compute the counterfactual labor share.

Figure E.1: Aggregate labor markdowns in manufacturing



Notes: The solid line plots the average labor markdown of Chinese manufacturing firms, weighted by firm's output. The dotted line plots the counterfactual labor markdown assuming input tariffs do not change since 2000.

Table E.1: Wage premium of skill-intensive firms over time

Dependent variable = $\log(\text{compensation per worker})$	
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2000\}$	0.212*** (0.005)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2001\}$	0.202*** (0.005)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2002\}$	0.185*** (0.004)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2003\}$	0.169*** (0.004)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2004\}$	0.147*** (0.003)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2005\}$	0.118*** (0.002)
$\mathbb{1}\{\text{skill intensive}\} \times \mathbb{1}\{\text{year}=2006\}$	0.119*** (0.002)
$\mathbb{1}\{\text{exporter}\}$	0.050*** (0.002)
$\log(\text{output})$	0.109*** (0.001)
Industry \times year FE	Yes
Industry \times location FE	Yes
Observations	690,772
Adjusted R-squared	0.339

Note: Standard errors clustered at the firm level are in parentheses. Significance: ***: 1%, **: 5%, *: 10%.